ASTM
INTERNATIONAL

WELCOME TO THE 2017 D22 JOHNSON CONFERENCE

JULY 31-AUGUST 4, 2017

UNIVERSITY OF VERMONT, BURLINGTON, VERMONT

Dudley H. Davis Center Building

http://www.uvm.edu/

GENERAL INFORMATION

ASTM International – On-site Contact: **Kelly Dennison, Symposia Manager**

Registration: Dudley H. Davis Center
Livak Fireplace Lounge – 4th Floor
Monday-Thursday, 7:30 am – 8:15 am

Everyone must check in at the ASTM Registration Desk to pick up your badge and program/booklet.

The Conference will start Monday, July 31, at 8:00 am and end on Friday, August 4, at 3:00 pm.

General Session Room: Grand Maple Ballroom – 4th Floor

Poster Session Room: Grand Maple Ballroom Lobby – 4th Floor
Monday – Thursday

Coffee Breaks: Livak Fireplace Lounge – 4th Floor
Monday – Friday (see technical program booklet for additional information)

Welcome Reception – Sheraton Burlington Hotel
Monday, July 31, 2017 - 6:30 pm
Diamond Ballroom (Conference Center-Lobby Level)

Hotel Information
Sheraton Burlington Hotel and Conference Center
870 Williston Road, Burlington, VT 05043
Phone: 802-865-6600 – Fax: 802-865-6617
http://www.sheratonburlington.com/

ASTM INTERNATIONAL

Complimentary Transportation Shuttle Schedule

Monday, July 31, 2017
7:30 am – Depart from Sheraton – Will run until 8:30 am
5:00 pm – Depart from University – Will run until 6:00 pm

Tuesday, August 1, 2017
7:30 am – Depart from Sheraton – Will run until 8:30 am
5:00 pm – Depart from University – Will run until 6:00 pm

Wednesday, August 2, 2017
7:30 am – Depart from Sheraton – Will run until 8:30 am
4:30 pm – Depart from University – Will run until 6:00 pm

Thursday, August 3, 2017
7:30 am – Depart from Sheraton – Will run until 8:30 am
5:00 pm – Depart from University – Will run until 6:00 pm

Friday, August 4, 2017
7:30 am – Depart from Sheraton – Will run until 8:30 am
3:30 pm – Depart from University – Will run until 4:30 pm

Walking Directions from the Sheraton Hotel
The walk is approximately 10-15 minutes. When leaving the hotel, turn right from the Sheraton Hotel onto Williston Road/Main Street. The Davis Center will be on your right after the Davis Center Oval.

Visitor Parking on Campus
The term "visitor is defined as any person who is not registered or pre-registered for classes and is not employed or temporarily employed by the University. Designated daytime visitor areas include a Pay-and-Display station at the College Street visitor Lot located near the intersection of College and South Prospect Streets. The Pay-by-Space station is adjacent to PFG Complex and Gutterson Fieldhouse, and the Jeffords Building. Also, visitors may utilize meters available in zoned parking areas and metered areas: Davis Center Oval, trinity Campus and Blundell House. Parking beyond maximum time limit posted on meters is prohibited. Meters specifically designated for Fleming Museum visitors require a special permit obtained from the Museum.

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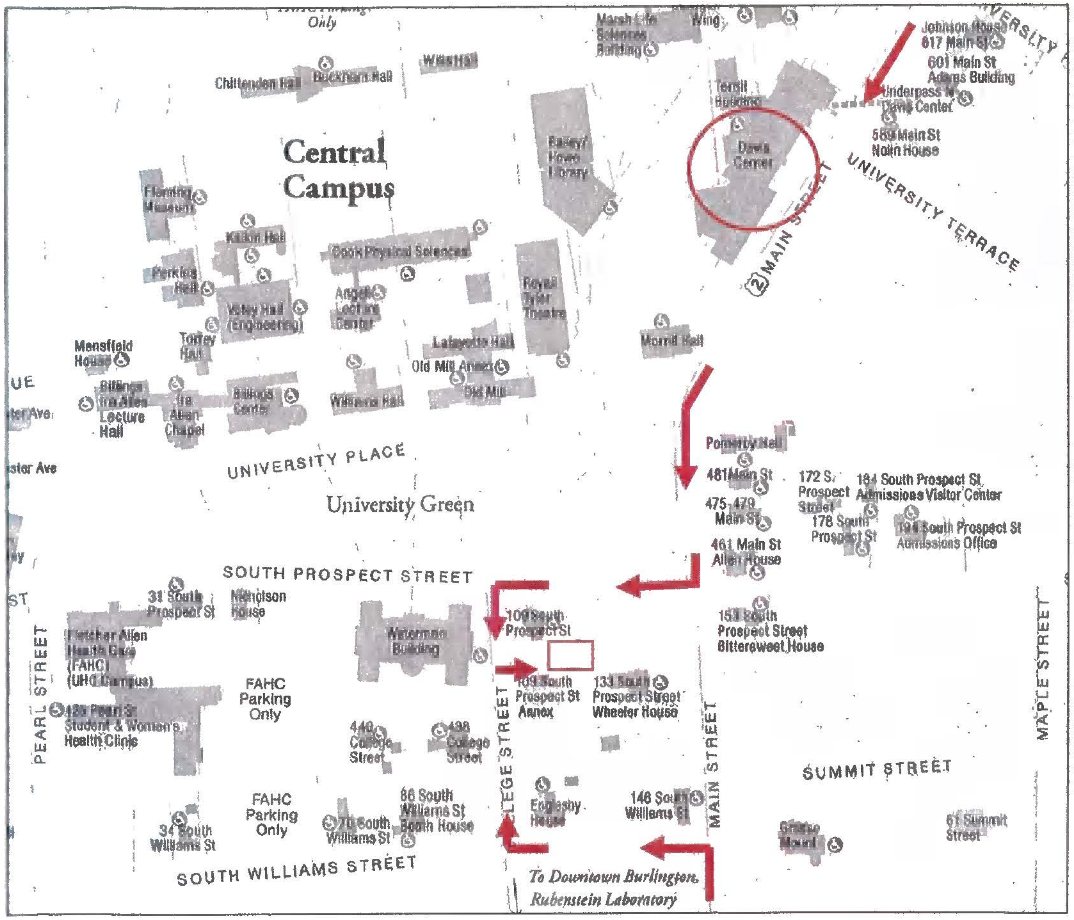
D22 Johnson Conference

July 31-August 4, 2017



Parking Paystation Code:

Directions for College St. Visitor's Lot Paystation

- Park your vehicle
- Go to the parking paystation near the entrance
- Select the amount of time you wish to park
- You will see "Insert Money Cash/Coin"
- Insert payment
- Take ticket
- Place ticket face up on vehicle dashboard

Map Key:

Driving Route (to College St. Visitor's Lot)

College St. Visitor's Lot

Dudley H. Davis Center - Conference Location

DIRECTIONS:

From highway: Take Exit 14W off I-89 on US Rte 2W/Roosevelt Highway/Main Street/Williston Road. Go past Davis Center (large brick building) and University Green, both on right. At traffic light immediately after Green, turn right onto South Prospect St. Turn left at next light onto College St. Take first left into College St. Visitor's Lot.

From downtown Burlington: Travel up hill on US Rte 2E/Main Street, turn left onto South Williams St. At next intersection turn right onto College St. Turn right into College St. Visitor's Lot.

The UNIVERSITY of VERMONT

UNIVERSITY EVENT SERVICES

Connecting to UVM's Wireless Network

Username: ues.astm118

Password: VaeKah9u

1. Turn on your laptop, tablet or other wireless device
2. Search for available wireless connections
3. Make sure to disable all other wireless connections except for *UVM Guest*
4. Connect to *UVM Guest* wireless connection
5. Open web browser such as Internet Explorer, Firefox, Chrome or Safari. You should automatically be redirected to the login page. If you are not automatically redirected please try visiting any other website.
6. Type in your username and password where indicated. Passwords, a mix of letters and numbers, are case sensitive, which means that lower- and upper-case letters matter.
7. Click *Log In*.

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Articles

Ellis, Wayne P. "Airborne Asbestos in Buildings: The Great Abatement Debate." *ASTM Standardization News* December 1988: 60-63. Print.

Quigley, Patricia. "The Johnson Conference: ASTM Standards Informed by Critical Research." *ASTM Standardization News* May/June 2014: 38-41. Print.

Airborne Asbestos in Buildings

The great abatement debate

by Wayne P. Ellis

Wayne P. Ellis retired, in 1983, as industry standards manager for the H.B. Fuller Co., and is now a standards consultant. He was president/chairman of the ASTM Board of Directors in 1980, and served a term as director from 1974 to 1982. Ellis' activity in ASTM dates from 1937, when he became a student member. He continues today as an active member of nine technical committees.

Airborne asbestos fibers are known to be extremely hazardous, based upon studies of both laboratory animals and asbestos workers and their families. Several life-threatening diseases, such as lung cancer and mesothelioma, can be caused by exposure to airborne asbestos. No safe threshold has been established for asbestos. Effects at low levels of nonoccupational exposure have been estimated by extrapolation from higher levels although the validity of this approach has not been empirically demonstrated. This is the position of the U.S. Environmental Protection Agency (EPA) and the basis for its regulatory actions requiring the abatement of asbestos in buildings.[1]

Based on the results of the EPA 1984 national survey, approximately 733,000 (20 percent) of the 3.6 million public and commercial buildings in the survey contain friable asbestos. Approximately 501,000 of these buildings contain damaged asbestos containing materials (ACM). About 317,000 buildings contain at least some significantly damaged ACM, commonly thermal insulation material usually found in building areas not used by the public, such as boiler and machinery rooms. Because of restricted access to building occupants, asbestos exposures in those areas would be limited primarily to service and maintenance workers.

EPA concluded that estimates of the number of persons exposed, the level of airborne asbestos exposure, the frequency or influence of episodic events that disturb asbestos, or the relative exposure levels of service workers in comparison with members of the general public are highly uncertain. That is so because limitations in the exposure data from the survey prevent quantitative conclusions or comparisons between schools and public and commercial buildings.

Government Regulation and Legislation

In 1986, the Occupational Safety and Health Administration (OSHA) issued a new standard for occupational exposure to asbestos, setting a possible exposure limit of 0.2 fiber per cubic centimetre (f/cc) of atmosphere, with an action level of 0.1 f/cc, applicable to construction and abatement work sites and to maintenance work. Asbestos exposure to office workers in buildings where ACM exists are deemed "occupational exposures" covered by the OSHA standard. However, because OSHA expects such exposures to be considerably below the 0.1 f/cc action level, it did not adopt specific regulatory language for such buildings.[2]

In 1970, congress, in the Clean Air Act, empowered EPA to establish guidelines known as the National Emission Standards for Hazardous Air Pollutants (NESHAP). Asbestos was listed as hazardous. Visible emissions from any process were prohibited, and the use of friable spray-on ACM in buildings or for any other purpose was banned. Under the Toxic Substances Control Act (TSCA), EPA, in 1982, required all schools to inspect for the presence of ACM and to notify the public if asbestos were found. EPA found that the presence of unidentified friable ACM and the absence of notice of proper handling techniques posed an unreasonable risk.

In 1984, congress established a program of financial assistance to schools with an immediate need for asbestos abatement but without funding. The act authorized appropriations of not more than $50 million for 1984 and 1985, and $100 million for each of the five succeeding years. Fifty million actually was appropriated in 1986, and $47.5 million in 1987.

After finding that EPA had not taken sufficient action in reducing asbestos hazards in buildings, congress, in 1986, passed the Asbestos Hazard Emergency Response Act (AHERA) requiring EPA to regulate response actions concerning friable ACM in schools. Response actions are defined as methods that protect human health and the environment from ACM; in other words, asbestos abatement actions.

The act required also that EPA study and report to congress on the extent and condition of ACM in public and commercial buildings, whether these should be subject to the same response actions as schools, whether the general public is adequately protected from exposure during abatement actions, and finally, whether there is need to establish standards and regulations to control risk of exposure in public and commercial buildings.

In February 1988, reporting to congress on its study, EPA recommended against regulating asbestos control in all public and commercial buildings, but proposed a three year program of training, education, and research, as well as an evaluation of its schools program. That program is expected to cost $3 billion; while the cost of a similar program for public and commercial buildings is estimated at $51 billion.

The Debate

Many people and organizations have questioned the cost/benefit of large-scale asbestos abatement actions. Abatement is the term used to cover four different actions recognized as suitable to control exposure to ACM in buildings: removal, enclosure, encapsulation with sealers, and a special operations and maintenance program designed to clean up any asbestos fibers previously released, to prevent future release by minimizing ACM disturbance or damage, and to monitor the condition of ACM until it is removed, or the building is demolished.

Opposition to abatement actions is based on findings by several credible organizations that exposure of building occupants to airborne asbestos is negligible. The mere presence of ACM in buildings does not of itself pose any hazard to occupants. Numerous studies, including those conducted by EPA and the Ontario Royal Commission,[3] have monitored asbestos levels in buildings constructed with ACM. In many cases, airborne levels have been so low as to be indistinguishable from outside air. In some, measurements show levels exceeding the outdoors by small amounts, and only a few have significantly exceeded outside levels. Even at the highest levels found, exposure is substantially lower than the OSHA standard. The Ontario Royal Commission concluded the "majority of exposures of building occupants in buildings with substantial amounts of friable asbestos would be to fibre levels less than 0.001 f/cc, with a few single readings as high as 0.01 f/cc representing the highest likely exposure."[4]

In the February 1988 report to congress, EPA found that the worst airborne asbestos levels in a sampling of 43 federal buildings containing ACM were no higher than levels found in the outdoor air. In attempting to quantify the total deaths from buildings asbestos exposure, EPA analysts estimated that

"Sometime, probably in the next decade, the enormity of the task to treat the 700,000 U.S. buildings containing asbestos containing materials will overwhelm the capacity to fund the work."

within the coming 130 years, 3,300 asbestos related fatalities will occur; that is, an average of 25 deaths per year. Driving an automobile to work is more than 150 times as hazardous. However, to the opponents of regulation of asbestos in buildings, these statistics are politically unacceptable within the government because environmental politics requires zero risk. Although EPA no longer will state that inhaling a single asbestos fiber causes cancer, it believes there is no level of exposure, however small, where the possibility can be ruled out.

Asbestos Abatement: The State of the Art

When government sponsored funding became available in 1984 to enable needy school districts to contract for asbestos abatement work, a business boom occurred. Hundreds of new contractor ventures bloomed. Many were unexperienced and incompetent to safely remove or treat ACM. Numerous cases arose in which airborne asbestos levels in treated buildings became higher than before abatement, simply because of improper work practices resulting from, among other problems, inadequate training of inexperienced and over eager contractor management and labor. Recognizing the magnitude of the contractor problem, EPA, in cooperation with selected colleges and universities, established accredited training courses. State regulations appeared, requiring that persons involved in asbestos management and abatement in buildings be certified by successfully completing one or more accredited courses.

In response to AHERA, EPA stepped up its review of field abatement problems and it developed more comprehensive and detailed procedures, guidelines, practices, and standards to upgrade the quality of abatement actions. EPA found that the quality of laboratory identification and measurement of both ACM and airborne asbestos often was inaccurate and imprecise. EPA established a laboratory qualification program in which laboratories were required to provide analytical data on reference materials. As the field of asbestos abatement contracting and laboratory analysis of bulk and air samples expanded drastically, many peripheral activities appeared. Asbestos oriented newsletters, journals, and equipment suppliers vied for a share of the action. Organizations of abatement contractors and related businesses were formed to discuss and resolve problems of management, operations, and litigation. Recognition of the need for new and improved consensus standards stimulated ASTM and others to undertake standards development.[5] But such standards need to be properly used to be effective. There must be concerted promulgation of standards in contract specifications, guidance documents, and, as appropriate, in regulations. Such use of standards provides improved levels of quality and consistency.

Laboratory Analysis and Measurement Problems

Laboratory techniques, primarily light and electron microscopy, are essential to the conduct of asbestos management and abatement in buildings. Bulk ACM as found in buildings is analyzed by polarized light microscopy (PLM) to identify and quantify asbestos content. Phase contrast microscopy (PCM) is used to count the fibers present in air samples. But limits of resolution and variation in capability of operators in light microscopy have resulted in inaccurate and misleading results at times. In the hands of an experienced microscopist who understands the limitations of the apparatus, these methods do yield results of impeccable quality.

Although certain test procedures (protocols) for the analysis of ACM and airborne asbestos fibers have been recognized by OSHA and EPA, and have been in use in analytical laboratories for several years, most have not been standardized through voluntary consensus procedures. That situation is being remedied now by action in Committee D-22 on Sampling and Analysis of Atmospheres to develop ASTM standard test methods.

AHERA requires that testing of air samples at completion of a removal abatement action be done by transmission electron microscopy (TEM). Standards for reoccupancy of the cleaned space (clearance standards) demand airborne fiber levels not higher than the ambient outdoor air. This requires accurate very low or near zero fiber counts. TEM analysis is uniquely fitted for this work. Because it is a much more sophisticated, complex, and accurate procedure, the cost of TEM analysis is at least ten times that of PCM analysis. PCM will continue to be used for testing during the progress of an abatement action, but TEM is appropriate and is required by AHERA for final clearance.

Training and Accreditation

EPA is placing new emphasis on the quality of laboratory measurement of asbestos samples. A quality assurance program will become a requirement for laboratory accreditation, which will be a new activity of the National Voluntary Laboratory Accreditation Program (NVLAP) conducted by the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards—NBS). Committee D-22 recently conducted a conference on the quality of microscopy measurement of ACM and air samples. EPA and NVLAP have agreed to use the consensus standards now being developed in D-22 for analysis of both ACM and airborne asbestos fibers in the accreditation process. The conference concluded with a comprehensive presentation of the new NVLAP program, now under way. NVLAP accreditation of asbestos testing laboratories will be in full force early in 1989.

Trends in Asbestos Control

The topic of indoor air contamination by airborne asbestos dust will continue to make headlines. The cost/benefit debate will continue but will not be disentangled from the web of environmental politics until both sides are willing to resolve the question of the appropriate value to be placed upon a life saved.[6] All of the controls being placed on the asbestos abatement process will improve its effectiveness, and undoubtedly increase its cost. Sometime, probably in the next decade, the enormity of the task to treat the 700,000 U.S. buildings containing ACM will overwhelm the capacity to fund the work. For that reason it seems most likely that routine monitoring of air quality in buildings holds the best promise of protecting occupant health. ●

References

[1] "EPA Study of Asbestos-Containing Materials in Public Buildings," A Report to Congress, Washington, DC, February, 1988.

[2] Arlene Fickler, "Federal and Local Legislation and Regulation Relevant to Asbestos-in-Buildings," New York, NY, Law Journal Seminars Press, 1988.

[3] "Report of the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario," Toronto, 1984.

[4] "What You Should Know About Asbestos in Buildings," The Safe Buildings Alliance, Washington, DC.

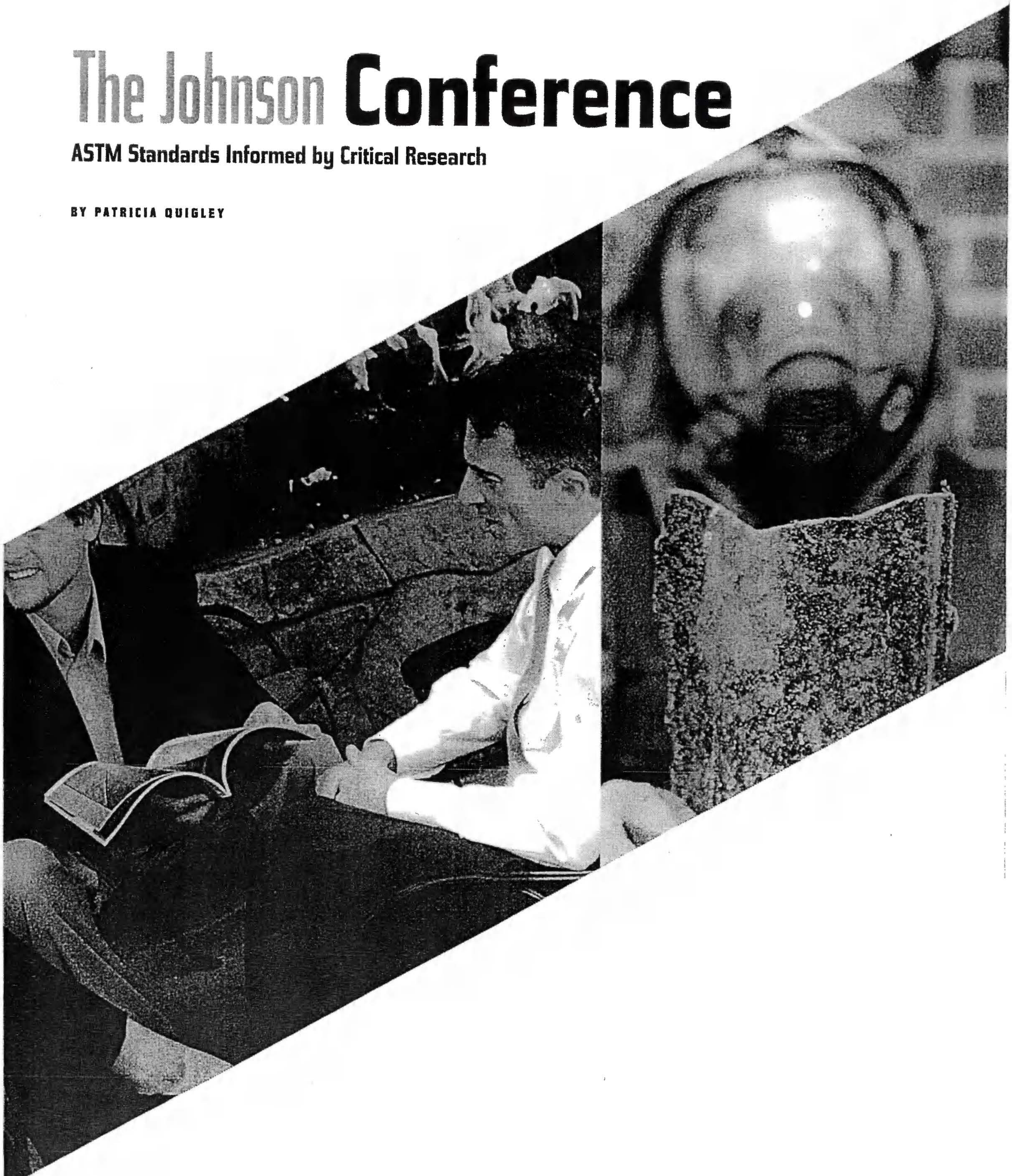
[5] Wayne Ellis and Morris Lieff, "Asbestos in Buildings: What Standards Are Needed?", ASTM, *Standardization News*, Philadelphia, June 1985.

[6] Walter Rosenbaum, "Environmental Politics and Policy," Washington, DC, *Congressional Quarterly*, Inc., 1985.

The Johnson Conference

ASTM Standards Informed by Critical Research

BY PATRICIA QUIGLEY



The Johnson Conference on Asbestos, held under the auspices of ASTM International Committee D22 on Air Quality, continues to provide the latest research related to asbestos, its sampling, monitoring and remediation, and more.

When more than 200 professionals from around the globe meet in bucolic Vermont every three years, they share the potential to impact health and business, to address past problems and future needs. These scientists, researchers, manufacturers, healthcare providers, attorneys and others attend the ASTM International Johnson Conference on Asbestos, which was started in the 1980s and is today a vibrant, albeit nonpublishing, group.

Under the auspices of ASTM Committee D22 on Air Quality, conference goers spend several days discussing and sometimes debating the latest research on a subject so safety-critical that the ASTM standards that arise from this research are utilized by governments to monitor and regulate asbestos. And the subject is so complex that conference participants find they are working even today to define it.

"That's what's great about the Johnson Conference," says Harry Rook, a 40-year member of ASTM, 35-year member and past chairman of Committee D22, and retired deputy director of the Materials Science Laboratory at the National Institute of Standards and Technology. "We get people in a room and we yell at each other for a week."

That might sound like Rook is making light of a serious subject, but he indeed knows just how important are both the conference and the committee-developed, consensus ASTM standards that eventually result from its oral presentations and posters.

ASBESTOS: WHAT IT IS, WHAT IT DOES

A fire retardant and sound absorber, asbestos could be, and still can be, found in or on floor tiles, pipes, ships, concrete and more. Asbestos also can be found in people's lungs, with deadly health consequences. According to the National Institutes of Health's National Heart, Lung and Blood Institute, when the tiny fibers in asbestos are inhaled they can remain in individuals' lungs for a long time. They can lead to such conditions as asbestosis, which scars lung tissue; lung cancer; and pleural and peritoneal mesothelioma, cancer of the linings of the lungs and abdomen.

Whether considered protective or destructive or both, asbestos is not a simple subject. This year's conference, the ASTM Johnson Conference on Asbestos, Almost Asbestos and Asbestos Progeny: New Challenges, will address the definition of this material as well as other current topics when it convenes July 21-25 at the University of Vermont in Burlington.

"One of the difficult problems in the asbestos area is that there are different

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ASTM COMMITTEE D22

ASTM International Committee D22 on Air Quality develops standards in all areas of air measurements. It has technical subcommittees on ambient, workplace and indoor air and has specialty subcommittees on quality assurance, source emissions, asbestos, mold and meteorology.

For more information about ASTM Committee D22, go to www.astm.org/COMMIT/D22 or contact Jeffrey Adkins, ASTM staff manager (phone: 610-832-9738; jadkins@astm.org).

Subcommittee D22.07 on Sampling and Analysis of Asbestos has 12 active and nine proposed standards. Among them are:

- D5755, Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading;
- D6281, Test Method for Airborne Asbestos Concentration in Ambient and Indoor Atmospheres as Determined by Transmission Electron Microscopy Direct Transfer;
- D6620, Practice for Asbestos Detection Limit Based on Counts;
- E1368, Practice for Visual Inspection of Asbestos Abatement Projects; and
- E1494, Practice for Encapsulation Testing of Friable Asbestos-Containing Surfacing Materials.

See the web address above for all standards developed by ASTM Committee D22.

definitions and terms used by different groups. Even the term 'asbestos' means different things to different people in the geology, medical, industrial hygiene and legal communities," says James R. Millette, Ph.D., executive director, MVA Scientific Consultants, Duluth, Ga., immediate past chairman of Subcommittee D22.07 on Sampling and Analysis of Asbestos, and current technical vice chairman of D22; and co-chairman of the conference with Rook, Larry Pierce and James Webber.

THE START

That description of the current state of affairs might sound like the early stages of a conference, but this one is several decades old and constantly evolving.

The late former Committee D22 chairman, Benjamin Levadie, professor of environmental studies at the University of Vermont and chief environmental health officer of the Vermont State Department of Health, started the conference in 1967, which was held until 2001 at the Vermont Johnson State College in Johnson, Vt.

Levadie had also helped start D22's Project Threshold to determine atmospheric concentrations of sulfur dioxide, nitrogen dioxide and health-impacting ozone; and he intended that the new conference would help gain input for Project Threshold and ASTM standards.

Early conferences focused on the science of measuring air pollutants, gases and particulates found in the atmosphere and on the quality assurance measures that laboratories needed to ensure reliable data, according to Rook. What happened at the conference, at least initially, stayed at the conference.

"One of Ben's innovations that continues today is that, since he wanted new ideas and the latest research, there was no publication of the presentations, and he directed that recording or quoting without the presenters' written permission was prohibited," says Rook. "What Johnson is about is to get us thinking about new ideas that we then go back to our laboratories and study. We don't publish so that people can bring their latest ideas and hopefully research that can be mulled over and agreed upon."

NEW IDEAS, FURTHER STUDY

By the mid-1970s, the conference had become a premier event on the measurement sciences of air pollutants, says Rook, who ran the conference from 1978 to 1988.

The first Johnson Conference to address the issue of asbestos was held in 1986. While early on only geologists and manufacturing engineers were interested in asbestos, by the early 1980s people had become more aware of the

> **"ASTM D22.07 standards are used every day in asbestos remediation, monitoring and contamination assessment. Samples of air, settled dust and soil are evaluated using ASTM standards developed by D22.07 to determine the amount and type of asbestos fibers present."**

impact of asbestos on health. Scientists, doctors and lawyers became even more interested in the subject and started flocking to the conference. By the late 1980s the conference evolved from complete focus on identification and quantification of asbestos — primarily in the air but also in dust, building materials and soil — through a time of "disarray" to new frontiers.

In 1988, the conference began attracting international participation, with people attending from Canada, Europe and the Far East. That year, Beard brought in presenters from the National Institute of Standards and Technology, which was mandated by Congress to develop a laboratory accreditation program for asbestos standards.

MAJOR GROWTH

By 1988 attendance had jumped from 40-60 participants to more than 100 attendees, a number that has more than doubled today.

Pierce, president and lab director at Fiberquant Inc., Phoenix, Ariz., says that every Johnson Conference, which is considered the premier international event on the subject of asbestos, has updates on state, federal and international regulations; provides information on the newest ASTM standards and regulatory methods of monitoring and analyzing asbestos; and highlights case studies of asbestos occurrence, remediation and contamination, among other topics.

THE RESULTING STANDARDS

Rook says the conference never would have progressed without Michael Beard, at one time the chairman of Subcommittee D22.07 on Sampling and Analysis of Asbestos, and senior research chemist and asbestos program manager for the U.S. Environmental Protection Agency at Research Triangle Park, N.C. Beard helped coordinate sessions in the 1990s from a hospital after being diagnosed with cancer, Rook says, from which he died in 2008. "I don't think we would ever have gotten consensus asbestos standards approved through ASTM. People on the subcommittee had very different ideas on the best methods for the identification and measurement of asbestos and on how you would use those methods in consensus standards," Rook says. "It was incredibly important to get the first standard out, and Mike made that happen. The impact has been huge. In the boardrooms of industry and in the courtroom, ASTM standards are now the gold standard."

Those standards are related to identifying and measuring asbestos fibers in air, dust, bulk materials and soil. Committee D22 worked with other committees interested in asbestos and developed measurement standards compatible with their scopes.

That the standards are important is a given, considering the weight of the topic and their application for such concerns as assessing the impact of the dust from the collapsed World Trade Center that coated residences and businesses in New York, N.Y., after Sept. 11, 2001.

Millette says, "As with many other ASTM methods, ASTM standards pertaining to asbestos are highly regarded in the industrial, legal and governmental communities. The Johnson Conferences have served as an important vehicle to foster open discussions among groups."

He adds, "ASTM D22.07 standards are used every day in asbestos remediation, monitoring and contamination assessment. Samples of air, settled dust and soil are evaluated using ASTM standards developed by D22.07 to determine the amount and type of asbestos fibers present. The techniques are used to understand the extent that a site might be contaminated with asbestos. Having standard methods that are used by all laboratories is critical to interpreting the data. When a method has been agreed upon by the consensus approach of ASTM, individuals reviewing data produced by different laboratories can have confidence that all the data will be reliable and comparable. Similarly the ASTM guides that have been produced by ASTM D22.07 for working with asbestos have been peer-reviewed and accepted by a committee composed of some of the most active and experienced practitioners in the asbestos remediation and asbestos analytical industry."

ON JULY'S AGENDA

In addition to ongoing work to clarify the definition of asbestos for all stakeholders, the nine sessions in this year's conference will touch on such topics as medical research, environmental monitoring and remediation, and litigation and science.

The conference coordinators expect environmental consultants; laboratory analysts and managers; building owners; epidemiologists; land use planners and regulators; and federal, state and local government officials to attend.

And today, the conference and ASTM's work continues.

PATRICIA QUIGLEY *is an award-winning journalist and public relations practitioner who has written for local, regional, national and international publications. She resides in southern New Jersey, where she earned a B.A. in communication and an M.A. in writing from Rowan University.*

snonline

See related new standards, meeting dates, publications, news and more at www.astm.org/sn-environmental.

INTRODUCTION

Welcome! ASTM International staff and the Johnson Conference co-chairs are excited about hosting another ASTM Johnson Conference.

As revealed in the two previous ASTM Standardization News articles, the conversation surrounding asbestos has been on-going and robust since 1986. This has included professionals from diverse aspects that are engaged in the often subtle and overlapping nuances of asbestos issues from the medical community, geology interests, commercial representatives, industrial hygiene experts, regulatory agencies, and legal interests. All gather in Vermont to present, debate, inquire, inspire, and share sometimes controversial thoughts and ideas to help move the science behind this topic. We are pleased to host several international presenters in this week's program. Insight from guests far and wide continues to sharpen both the challenges of asbestos, as well as unforeseen avenues of cooperation and solutions from varied viewpoints. At Johnson, freedom to express viewpoints among colleagues abounds, but recordings of any type are prohibited and no publications will be forthcoming. Creating this safe place for frank and lively discussion has produced key pieces to assembling the puzzle that is this ever-complex mineral.

If this is your first Johnson Conference, congratulations, there is plenty to enjoy on campus, in Burlington, and around the mountains and lakes of Vermont. If you are a veteran of multiple conferences you know that ideas are exchanged not only during the program and poster sessions, but also during breaks, at dinner, and perhaps even while lifting a glass at one of many microbreweries in town. It is really a time to renew old friendships and to forge new ones based upon a shared interest of asbestos. We look forward to your participation as a member of this unique community this week and in the years to come.

2017 Johnson Conference Co-Chairs

James R. Milllette, millette1951@gmail.com
Frank Ehrenfeld, frankehrenfeld@iatl.com
Michael Breu, michaelb@fiberquant.com
James S. Webber, jswebberasbestos@gmail.com

Organizing Committee for Workshop: Novel Research Findings on Asbestos Health Effects
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Poster Sessions
Posters will be presented from Monday through Thursday of the Johnson Conference in the lobby of the lecture auditorium. Poster presenters will be at their posters for discussion during morning and afternoon breaks as well as for one half hour before the morning session begins and for one half hour after the afternoon session adjourns.

Volleyball at the Johnson Conferences
A volleyball grudge match between the commercial sector (Team Entrepreneurs) and the regulatory and non-profit sector (Team Endless Red Tape) have been a mid-week staple at Johnson Asbestos Conferences since 1988. Team Endless Red Tape has won seven of the eight matches to date. If conditions are suitable, we anticipate a ninth re-match during this year's conference. Stay tuned.

PROGRAM

MONDAY, JULY 31, 2017

SESSION 1: WORKSHOP ON NOVEL RESEARCH FINDINGS ON ASBESTOS HEALTH EFFECTS

7:30 AM	Registration, Poster session opens
8:00 AM	Welcome – James S. Webber, Ph.D., Johnson Conference Co-Chair
8:15 AM	Introduction – Deborah Keil, Ph.D., Montana State University

Non- Cancer Outcomes Session (Moderator: Deborah Keil, Ph.D., Montana State University)

8:30 AM	Speaker: Jean Pfau, Ph.D., Montana State University
9:00 AM	Panel member #1: Brad Black, M.D. Center for Asbestos Related Diseases, Libby MT.
9:20 AM	Panel member #2: Bob Benson, Ph.D. U.S. Environmental Protection Agency, Region 8
9:40 AM	Panel member #3: Arnold Brody, Ph.D. Tulane University Medical School
10:00 AM	Panel & Audience Discussion
10:45 AM	**BREAK**

Asbestos Biomarker Session (Moderator: Jean Pfau, Ph.D.)

11:00 AM	Speaker: Harvey Pass, M.D., New York University, Langone Medical Center
11:30 AM	Panel member #1: Ian Blair, Ph.D., University of Pennsylvania
11:50 AM	**LUNCH** (On your own)
1:00 PM	Panel member #2: Raphael Bueno, M.D., Harvard Medical School
1:20 PM	Panel member #3: Arti Shukla, Ph.D. University of Vermont, College of Medicine
1:40 PM	Panel & Audience Discussion
2:20 PM	**BREAK**

Cancer Outcomes Session (Moderator: Arti Shukla, Ph.D.)

2:30 PM	Panel member #1: Prasad S. Adusumilli, M.D., Weill Cornell Medical Center, New York
2:50 PM	Panel member #2: David W. Kamp, M.D., Northwestern University Medical School
3:10 PM	Panel member #3: Andrey Korchevskiy, Ph.D., Chemistry & Industrial Hygiene, Inc
3:30 PM	Speaker: Christopher Weis, Ph.D., NIEHS
4:00 PM	Panel & Audience Discussion (Additional Participants: Poster presenters)
4:45 PM	Wrap up (Jean Pfau)
6:30 PM	**Reception at Sheraton Hotel** (cash bar)

TUESDAY MORNING, AUGUST 1, 2017
SESSION 2: GEOLOGY – Session Co-Chairs: Mickey E. Gunter and Sean Fitzgerald

8:00 AM
Poster session opens

8:20 AM Introduction and Announcements – Frank Ehrenfeld, Johnson Conference Co-Chair

8:30 AM
Towards a training program for geologists and other asbestos professionals working on NOA projects
R. Mark Bailey, Bradley Erskine

8:50 AM
NOA at the Calaveras Dam Replacement Project: A status report
Bradley Erskine

9:10 AM
Conceptual model for surficial redistribution of naturally occurring asbestos in arid and semi-arid landscapes: Case study in southern Nevada, USA
Brenda J Buck, Rodney V. Metcalf, Brett T. McLaurin

9:30 AM
Update on erionite
Martin Harper

9:50 AM
Erionite analysis by TEM
Robyn Ray

10:10 AM **BREAK**

10:30 AM
Two modes of fibrous growth habit in amphiboles
Rodney V. Metcalf, Brenda J. Buck

10:50 AM
Proposal of a partition in the diagram Si vs. Mg / Mg + Fe, taking into account all calcic asbestiform amphiboles
Maxime Misseri, Didier Lahondere

11:10 AM
Additional XRD and pre-concentration developmental work on the determination and characterization of erionite and other zeolites in support of ASTM Work Item, WK 39550, PLM analysis of soils and gravels and NIOSH (Martin Harper) evaluations for erionite by PLM, microprobe, and TEM analyses
Gary P. Tomaino

11:30 AM

Using stable O and H isotope ratios to constrain conditions of talc formation in southwest Montana and other economically significant locations

Marian E. Buzon, Mickey E. Gunter

11:50 AM

Mineralogical resources for those dealing with respirable mineral dust

Mickey E. Gunter

12:10 PM **LUNCH** (On your own)

TUESDAY AFTERNOON, AUGUST 1, 2017

SESSION 3: REGULATORY PERSPECTIVES – Session Co-Chair: Myron Getman

1:40 PM

ASTM E2356-14 "Standard Practice for Comprehensive Building Asbestos Surveys" - The application to industry

Tom Laubenthal

2:00 PM

Asbestos at the source: understanding the differences between regulated commercial asbestos, asbestiform minerals in rocks, and false positives

Don Halterman

2:20 PM

Avoiding 1%: analytical mindfulness and statistical monitoring

Frank Ehrenfeld

2:40 PM

Finalizing the Libby Action Plan Research Program

Maureen R. Gwinn, David L. Berry, Andrea Kirk, Annie Jarabek, David Bussard, Ronald Hines, Deborah McKean, Michael Scozzafava

3:00 PM **BREAK**

3:20 PM

State asbestos regulations between the lines: What is the nature of enforcement?

Thomas B. (Brad) Mayhew

3:40 PM

Rainbows and colored pencil drawings: the fallacy of determining a numeric refractive index from dispersion staining colors

Don Halterman

4:00 PM
Peggy Forney: USEPA National Enforcement Investigative Center Career Achievement
Frank Ehrenfeld

4:20 PM
Death by point counting
F. Stephen Masek

4:40 PM **AFTERNOON SESSION ADJOURNS**

WEDNESDAY, AUGUST 2, 2017
SESSION 4: DEVELOPING ANALYTICAL METHODS – Session Chairs Frank Ehrenfeld and Jeanne Spencer

8:00 AM
Poster session opens

8:20 AM Introduction and Announcements – Michael Breu, Johnson Conference Co-Chair

8:30 AM
Challenges of reconciling two asbestos testing laboratories' analytical results on an NOA job site with complicated amphibole mineralogy
R. Mark Bailey, John Harris

8:50 AM
ASTM dust methods: The effects of the ultrasonic preparation technique on asbestos concentration, how to interpret the results
Andreas Saldivar, Leonard Burrelli

9:10 AM
Pharmaceutical and cosmetic talc: XRD methodology and statistics for identification, detection limits and limits of serpentine in support of ASTM WK 30352 and 2015-2020 USP Expert Talc Panel –Test Methods
Gary P. Tomaino

9:30 AM
Fluidized bed asbestos segregator – Inter-laboratory round robin
Jed Januch, David Berry, Lynn Woodbury

9:50 AM
Update on new methods for asbestos in pharmaceutical grade talc
Martin Rutstein, Julie Pier, Daniel Crane, Sean Fitzgerald, Mickey Gunter, Don Halterman, Kate Houck, Lee Poye, Matthew Sanchez, Alan Segrave, Gary Tomaino, Drew VanOrden, James Webber, Jeffrey Medwid (FDA), Steven Wolfgang (FDA), Kevin Moore

10:10 AM **BREAK**

10:30 AM
Concentration methods improve detection limits for the analysis of talc for asbestos
Julie W. Pier

10:50 AM
Effectiveness of PLM for the analysis of chrysotile asbestos spiked into talc
Julie W. Pier

11:10 AM
Libby and other amphiboles, the ends are in sight
Jeanne Spencer

11:30 AM
Optical analysis of the fibrous/acicular zeolites: A spindle stage approach
Kristina Pourtabib, Mickey Gunter

11:50 AM **LUNCH** (On your own)

1:40 PM
Electron backscatter diffraction for phase Identification in asbestos analysis: Real world case studies
Bryan Bandli

2:00 PM
Comparison between PCM and TEM analysis of filters loaded with LA-spiked soil standards using the FBAS preparation method
David Berry, Lynn Woodbury

2:20 PM
Update on ASTM WK52495: Standard Test Method for Qualitative Determination of Fibers Consistent with Libby Amphibole Asbestos Fibers in Loose Fill Vermiculite by Transmission Electron Microscopy
Jeanne Spencer – affordable to homeowners. To i.d. Libby vermiculite in the home. To protect and caution the user.

2:40 PM
Insight into the analysis on dispersion staining curves
Derek Ho

3:00 PM **BREAK**

3:20 PM
Examples of determining the detection limit for asbestos analysis using ASTM6620
James R. Millette

3:40 PM
Micro-Raman and Wavelength Dispersive Spectroscopy (WDS) analysis comparison of samples from former talc mines in the Gouverneur Mining District, New York.
Brittani D. McNamee, Aaron Celestian

4:00 PM **AFTERNOON SESSION ADJOURNS**

THURSDAY MORNING, AUGUST 3, 2017
SESSION 5: METHODS AROUND THE WORLD & MISCELLANEOUS – Session Co-Chairs: Eric J. Chatfield & James S. Webber

8:00 AM
Poster session opens

8:20 AM Introduction and Announcements

8:30 AM
Measuring asbestos in heavy dusting conditions
Reiner Köenig

8:50 AM
ASBestos-IN-Soil (ASBINS) - Australian experience
Ross McFarland

9:10 AM
Drywall joint compound by visual estimation, point counting, and TEM
Andreas Saldivar

9:30 AM
Framework for assessment and phytoremediation of asbestos-contaminated sites
Brenda B. Casper, Cédric Gonneau

9:50 AM
Site assessment and characterization of talc at Fontana, Gianna and Paola horizons, Italy
Alan Segrave

10:10 AM **BREAK**

10:30 AM
ISO standard methods for determination of asbestos
Eric J. Chatfield

10:50 AM
Evaluation of friction materials for asbestos and investigation of fiber release
Steve Compton

11:10 AM
Asbestos-containing materials associated with steam locomotives
William Ewing

11:30 AM
Italian asbestos superfund: the importance of on-site surveys, sampling and analysis
Federica Paglietti, S. Malinconico, B. Conestabile della Staffa, S. Bellagamba, P. De Simone

11:50 AM
Asbestos-cement's underground networks: technical, operational and safety issues.
Sergio Malinconico, F.Paglietti, B. Conestabile della Staffa, S. Bellagamba, P. De Simone

12:10 PM **LUNCH** (On your own)

THURSDAY AFTERNOON, AUGUST 3, 2017
SESSION 6: LEGAL ASPECTS – Session Co-Chairs: James. R. Millette & Drew Van Orden

1:40 PM
The case of asbestos-containing cigarettes
James R. Millette

2:00 PM
Differentiation of amphiboles and inadequacy of current methods for asbestos analysis
Sean Fitzgerald

2:20 PM
Asbestos exposure litigation case types: what is hitting the courtrooms today
Sean Fitzgerald

2:40 PM
Taz and Sons: bad removal of asbestos coated pipeline
Peggy Forney

3:00 PM **BREAK**

3:20 PM
Liberty fibers: asbestos NESHAPs investigation, criminal prosecution and Superfund Victim Restitution Order
Ann Strickland, Peggy Forney

3:40 PM
Evaluation of the proposed correction factor for comparing the ratio of indirect and directly prepared TEM samples containing amphiboles
Drew Van Orden

4:00 PM

Serpentine and amphibole group mineral characterization in talc ores and talc based products accurate, repeatable, and defensible SAED evaluations

Matthew S. Sanchez, Monica Mcgrath, Long Li

4:20 PM

Detect or not to detect: a discussion on when is zero actually zero?

Richard Lee, Bryan Bandli, Drew Van Orden, Matt Sanchez

4:40 PM **AFTERNOON SESSION ADJOURNS**

FRIDAY, AUGUST 4, 2017

SESSION 7: RISK EVALUATION – Session Co-Chairs: Julie Wroble and Martin Harper

8:20 AM Introduction and Announcements

8:30 AM

The good, the bad, and the ugly: Selecting analytical methods for different purposes

James S. Webber

8:50 AM

Elongate mineral particles: What should be measured?

Eric J. Chatfield

9:10 AM

A new PCM equivalent TEM method for risk assessments

John Harris

9:30 AM

Comparison of PC and TEM-PCME concentrations for nearly 10,000 air samples collected from the Libby asbestos superfund site

Lynn Woodbury, Erin Formanek

9:50 AM

A Bayesian approach for estimating exposure point concentrations with low count asbestos air data

Ralph Perona

10:10 AM **BREAK**

10:30 AM

Mesothelioma in Jefferson Parish, Louisiana: A follow-up of America's largest current asbestos epidemic

Bruce W. Case

10:50 AM
Chrysotile in California reservoir water: Is it an H&S impact?
Bradley Erskine

11:10 AM
Asbestiform minerals in nature, legal jurisdiction, and areas of responsibility: The Boulder City, Nevada, bypass project as a case study of misunderstanding and misconception
Don Halterman, Dan Crane

11:30 AM
River Street Warehouse Fire: A Case Study of an EPA Emergency Response (when it rained asbestos on Portland)
Julie Wroble

11:50 AM **LUNCH** (On your own)

1:30 PM
Asbestos soil remediation: In situ versus excavation and disposal off site respirable asbestos in soil
Shimson Lerman

1:50 PM
Respirable asbestos in soil
Ed Cahill

2:10 PM
Use of FBAS prepared soil samples to make cleanup decisions at an ACM-contaminated site
Tim Frederick, David Berry

2:30 PM
Our experience with three different preparation methods for lung tissue fiber burden analysis
Ed Cahill

2:50 PM
Closing Remarks
James R. Millette, PhD., Johnson Conference Co-Chair

3:00 PM **CONFERENCE ADJOURNS**

ABSTRACTS

Johnson Conference 2017

Abstracts for Monday, July 31, 2017

SESSION 1: WORKSHOP ON NOVEL RESEARCH FINDINGS ON ASBESTOS HEALTH EFFECTS

Non-Cancer Outcomes Session

Differential Non-Cancer Outcomes of Fibrous Amphiboles in Mice

Jean C. Pfau and Deborah E. Keil, Montana State University
Brenda Buck and Rod Metcalf, University of Nevada, Las Vegas

Novel research findings are forcing us to consider a paradigm shift in the assessment of health outcomes of asbestos exposure. First, non-cancer outcomes must be considered as sensitive and impactful measures, potentially occurring at very low levels of exposure. The experience with Libby Amphibole (LA) has taught us that exposure predominantly causes a non-malignant pleural disease that has a progressive and atypical clinical presentation, and can increase the risk of systemic autoimmune diseases. Our studies also suggest that the two may be related mechanistically. Further, it is clear that we cannot assume that different types of fibers will have the same outcomes; therefore, fiber-specific risk assessments must take these non-cancer outcomes into account. The public health impacts of these findings are highlighted in the growing awareness of "naturally occurring asbestos" in places where it was not previously predicted to occur, leading to environmental exposures in wide areas of the U.S. A mouse model has been used to compare the non-cancer effects in mice of exposure to LA with those of a newly discovered mixture of amphibole fibers from Arizona. We now know that the immune system plays a profound role in directing the outcomes of exposure, including cytokine shifts and development of autoantibodies, which can affect the ability to fight cancer, produce fibrosis or result in autoimmunity. We hypothesized that subtle differences in size and chemistry of fibers can affect the resulting immune dysfunction, and that the immune profile may predict ultimate health outcomes. The results demonstrated that LA is not unique in producing autoimmune outcomes in mice, and yet supported our hypothesis that the Arizona amphibole would have a somewhat unique immune profile despite chemical and morphological similarities with LA. Importantly, we are demonstrating immune changes and autoantibodies at very low exposure levels in mice.

Fibrous Amphibole in Libby, Montana: Unique Biologic Response?

Brad Black, MD, Center for Asbestos Related Disease, Libby, Montana

The asbestos paradigm has held to the belief that asbestosis is on the decline, and pleural plaques are simply a marker of exposure and not associated with significant disease. In the early 1990s, a Spokane pulmonologist recognized a progressive pleural disease in Libby patients he had been following who had been exposed to the unique mineral fiber mix called Libby Amphibole Asbestos (LAA) that contaminated the mined vermiculite. The general phenotypic pattern is of pleural progression, whether plaque or diffuse pleural fibrosis, usually with relatively mild interstitial fibrosis. Nonmalignant morbidity/mortality from environmental exposure as well as occupational exposure has been observed. Additional atypical clinical patterns associated include 1) severe, intractable chest pain 2) episodes of rapid progression 3) prevalence of positive ANA serology (in 25%). Observations in the Libby Amphibole cohort (over 7,000 patients) followed by the Center for Asbestos Related Disease in Libby, MT for over 16 years suggest atypical mechanisms of disease. Furthermore, radiographic features have created new challenges in screening detection and quantification of disease.

Non Cancer Exposure-Response Modeling for Libby Amphibole Asbestos

Robert Benson[a], David Berry[a], James Lockey[b,c], William Brattin[d], Timothy Hilbert[b], Grace LeMasters[b]

[a] Environmental Protection Agency, Region 8, Denver, CO

[b] University of Cincinnati, Department of Environmental Health, Cincinnati, OH

[c] University of Cincinnati, Department of Internal Medicine, Cincinnati, OH

[d] SRC Inc., Denver, CO

The United States Environmental Protection Agency (EPA) developed a quantitative exposure-response model for the non-cancer effects of Libby Amphibole Asbestos (LAA). The model is based on the prevalence of localized pleural thickening (LPT) in workers exposed to LAA at a workplace in Maryville, Ohio, that used vermiculite ore from Libby, Montana, to produce commercial products. These modeling results were summarized in the Toxicological Review of Libby Amphibole Asbestos and was posted on the IRIS site in 2014. The modeling results were used to derive the Reference Concentration (RfC) for LAA. These modeling results will be presented and discussed. In addition, modeling results for an alternative cohort were also summarized in the Toxicological Review of Libby Amphibole Asbestos. These additional modeling results, which support the RfC, will also be presented and discussed.

Subsequent to the development of EPA's RfC, Lockey et al. (2015) published a follow-up study on the health status of surviving Marysville workers. The data from this study increases the number of cases of LPT, Diffuse Pleural Thickening (DPT), and Small Interstitial Opacities (SIO) and extends the observation period in these workers. EPA Region 8 combined these new data with the previous data to update the exposure-response modeling for LPT and also modeled the DPT and SIO endpoints (Benson et al., 2015). These new modeling results will be presented and compared to the previous results.

SEM, TEM and IHC Reveal the Deposition Pattern and Translocation Pathways of Inhaled Asbestos Fibers That Cause Lung Injury, Fibroproliferative Disease and Cancer

Arnold R. Brody, Ph.D.,
Professor Emeritus, Department of Pathology, Tulane University Medical School, New Orleans, LA

All asbestos varieties cause asbestosis, lung cancer and mesothelioma. The fundamental mechanisms through which inhaled fibers mediate these diseases are being uncovered. Before we could embark on studies at the molecular level, it was necessary to determine the deposition and distribution patterns of the inhaled fibers after exposure and through the consequent levels of injury that result in disease. We used SEM and TEM to establish that inhaled fibers are intercepted at the bronchiolar-alveolar duct (BAD) junctions where they are transported by the Type-1 alveolar epithelium to the underlying interstitial space that includes connective tissue, blood and lymph flow and macrophages. About 20% of the fibers that deposit on the epithelium reach the interstitium, and a proportion of those are translocated to the mesothelial surfaces of the thoracic and peritoneal cavities. There is rapid injury to the Type-1 epithelial gas-exchange surfaces as evidenced by an alveolar leak containing plasma proteins, including the third component of complement (C) that is activated by asbestos to form C5a, a powerful chemo-attractant for macrophages and other inflammatory cells. To repair the asbestos-induced injuries, Type-2 epithelial cells, bronchiolar Clara cells and vascular smooth muscle and endothelial cells undergo rapid and prolonged proliferation, largely driven by the expression of transforming growth factor (GF) alpha (TGFa) and platelet-derived growth factor (PDGF) A and B chain peptides. Over the next few days, fibroblast, myofibroblast and smooth muscle cell proliferation are mediated by PDGF, and there is an increase in interstitial matrix, mediated by transforming growth factor beta (TGFb). My laboratory has focused on genes that control cell proliferation, including tumor necrosis factor alpha (TNFa) that controls the expression of TGFb by the MEK/ERK pathway and AP1 transcription in various lung cells. In situ hybridization of the genes that code for these GFs, as well as laser capture micro-dissection and real time-polymerase chain reaction showed that the genes coding for these growth factors were expressed in a dose responsive manner with the highest expression at the BAD junctions and the lowest at the pleural regions. Even though there was low gene expression at the pleural surfaces, there were significant increases in the number of proliferating mesothelial cells at 2 and 8 days post-exposure to chrysotile asbestos. Mice that had the genes coding for both TNFa receptors knocked out were significantly protected from the asbestos-induced fibroproliferative disease process. Inasmuch as proliferating cells are more likely to undergo genetic alterations that lead to neoplastic events, it will be essential to control the expression of these factors that mediate cell proliferation consequent to asbestos exposure.

Asbestos Biomarkers Session

Discovery and Validation of Mesothelioma Biomarkers

Harvey I. Pass MD and Haining Yang PhD
Department of Cardiothoracic Surgery, NYU Langone Medical Center, New York and the University of Hawaii Cancer Center, Hawaii

The development of diagnostic and prognostic plasma biomarkers for thoracic malignancies requires novel technologies as well as appropriate case/control cohorts for discovery and validation. Specifically, the asbestos related malignancy, mesothelioma, is often detected in later stages with little chance for long term survival. The EDRN Mesothelioma Biomarker Discovery laboratory represents institutions with unique expertise in the development and technical validation of innovative platforms using plasma or imaging algorithms for the diagnosis of thoracic malignancies. Building on promising preliminary data, three plasma mesothelioma markers (FBLN3, SOMAmer 13 classifier, and HMGB1 Isoforms), will undergo further refinement and potential validation. The consortium will have access to discovery and validation cohorts from the mesothelioma (N=202), lung cancer (n=760), and control (n=419) plasma archives at NYU. The NYU Biomarker Discovery Laboratory, with technical assistance from its EDRN associate member SomaLogic, will construct a novel Luminex based assay (LuSoma) which will consist of 13 slow-off-rate-modified-aptamers (SOMAmers) and a newly constructed FBLN3 SOMAmer. The new assay will undergo technical validation, followed by further validation of previous published work from the NYU BDL that the AUC differentiating MPM from AE remains greater than 0.9. The University of Hawaii, using 202 pleural effusions from the NYU BDL, will investigate the sensitivity/specificity of HMGB1 and its isoforms with a unique, technically validated, electrospray ionization liquid chromatography tandem mass spectrometry to differentiate MPM from non-MPM benign and non-MPM malignant effusions. The HMGB1 effusion results will be compared to those obtained with the LuSoma assay described above. Validation cohorts from the already approved EDRN MPM screening program in Santiago, Chile, as well as from University of Toronto and South Glasgow University Hospital are already in place. Research Support from UO1 CA 086402, NCI/NIH, 2U24OH009077-08, CDC, 2U01CA 111295-04 (Subaward), NCI/NIH, and CA150671P2, DOD.

Serum protein biomarkers of mesothelioma and asbestos exposure

Ian A. Blair, PhD and Liwei Wang, PhD, University of Pennsylvania, Philadelphia PA

High mobility group box-1 (HMGB1) is a non-histone chromosomal protein that is highly conserved in eukaryotic cells. It is known to play a regulatory role in inflammatory immune responses and has recently proved to be a potential novel therapeutic target in malignant mesothelioma (MM). HMGB1 normally locates in the nucleus. During cell necrosis due to asbestos fibers, HMGB1 undergoes acetylation followed by translocation from the nucleus to the cytoplasm, and then secreted to extracellular space, where it binds to and activates pro-inflammatory mediators. Given the role it plays in inflammatory processes, HMGB1 may hold promise as a biomarker of cell transformative processes and thus hold utility as an indicator of asbestos exposure. A recent study revealed that serum levels of HMGB1 were increased in asbestos-exposed individuals as compared to both smoking and non- smoking controls by using an ELISA kit. This finding indicates the potential usage of serum HMGB1 levels in assessing asbestos exposure in human populations. In agreement with this finding, serum levels of HMGB1 have also been reported to be elevated in MM patients using an HMBG1 ELISA kit. Herein, we developed a stable isotope dilution HPLC-MS method, which has higher sensitivity and specificity compared with currently available HMBG1 ELISAs, to accurately quantify the HMGB1 levels in serum. Glu-C digestion of HMBG1 yields specific peptides including two nuclear localization signal (NLS) fragments. These two key peptides are highly acetylated, which prevents HMGB1 from reentering the nucleus. Thus, detection and accurate quantification of these two highly acetylated peptide may provide a useful biomarker to assess the progress of MM and/or exposure to asbestos. For expressing isotopically labeled HMGB1, HEK293 cells were cultured in the RPMI media containing [13C6,15N2]-lysine and [13C9,15N1]-tyrosine for at least 3 split before transfection. The plasmid of the conjugation of GST and HMGB1 was transfected into HEK293 cells. The cells were lysed 24 h after transfection and the cell lysate was incubated with GSH Sepharose beads at 4°C overnight. TEV enzyme, 1 mM DTT and the buffer were added to the beads afterwards, and the mixture was incubated at 4°C overnight. The supernatant was then collected and solution was stored at -20°C until use. Pierce protein A/G beads were incubated with HMGB1 antibody (Sigma) and the mixture was rotated and tilted at r. t. for 1 h. After removing the supernatant, the beads were mixed with the human serum (50 mL). The mixture was rotated and tilted at 4°C overnight. Acetylation of HMGB1 was conducted with acetic anhydride, To purified/enriched HMGB1 was added 1 mM TCEP, 25 mM NH_4HCO_3, 10% CH_3CN and Glu-C (protein:protease = 10:1). The digestion was carried out at 37°C overnight. The digested peptides were purified by C18 column and analyzed by ultra-high performance liquid chromatography-high resolution mass spectrometry. Immunopurification coupled with stable isotope dilution methodology made it possible to reliably quantify bioh free and acetylated forms of HMGB1 in the serum of mesothelioma patients and asbestos-exposed individuals.

Novel Diagnostics and Therapeutic Modalities for Mesothelioma

Raphael Bueno, MD
Division of Thoracic Surgery, Brigham and Women's Hospital, Boston, MA

Malignant Pleural Mesothelioma is an aggressive cancer usually resulting from prior exposure to asbestos fibers. We have been engaged in the study of tumor biology from the point of view of biomarkers that may facilitate diagnosis, prognosis and prediction of response. We previously developed a gene expression signature to define the risk of recurrence after surgery for Mesothelioma. We recently validated this signature and a multi-platform prognostic test that includes molecular biomarkers as well as pathological and radiographic data in a large prospective cohort of patients including both surgical and non-surgical cases. In parallel, we recently completed and reported in Nature Genetics a comprehensive Omic profiling of 216 mesothelioma tumors. We demonstrated that the tumors cluster into at least 4 concensus groups based on gene expression and that these groups have inherent additional prognostic features. We also described the most common mutations associated with mesothelioma. Finally, we embarked upon window of opportunity trials with biological compounds with some significant response in mesothelioma, likely associated with immune modulation, to define predictive tests. Some of these studies have been funded by grants from the NCI.

Asbestos-induced mesothelial cell pathogenesis: What is new?

Arti Shukla, PhD
Department of Pathology and Laboratory Medicine, College of Medicine, University of Vermont, Burlington, VT 05405

Asbestos causes mesothelial cell pathogenesis leading to fibrosis or malignant mesothelioma (MM). Although there is no dispute about the role of asbestos in the process, how asbestos fibers reach mesothelial cells and initiate these diseases is still not well understood. Our lab focuses on understanding the role of recently discovered inflammasomes in the process of asbestos-induced mesothelial to fibroblastic transition (MFT) leading to MM. We have also learned from our studies that chemotherapeutic drugs can modulate inflammasomes in MM tumor cells, and a combination of chemotherapeutic drug and IL-1receptor antagonist may be a better strategy to treat MM than chemotherapy alone. In addition, we are exploring the possibility that asbestos can affect epithelial cells and macrophages, resulting in the secretion of exosomes loaded with specific signature molecules. These exosomes can then target mesothelial cells of pleural and peritoneal cavity, unload their cargo and initiate the process of transformation. Some related data will be shared with the scientific community at the workshop. This research is financially supported by NIEHS (RO1 ES 021110) and DoD (W81XWH-13-PRCRP-IA)

Cancer Outcomes Session

Tumor immunology and immunotherapy for pleural mesothelioma

Prasad Adusumilli, M.D., Weill Cornell Medical Center, New York
adusumip@mskcc.org

Abstract - Malignant pleural mesothelioma has been marked historically by poor prognosis. Current standard of care for this disease results in sub-optimal improvements in overall survival, which has prompted researchers to explore innovative treatment alternatives. Investigating solid tumor immunology and translating the knowledge to develop immunotherapy is an emerging therapeutic modality that harnesses the power of the human immune system. Even in a deadly disease such as pleural mesothelioma, our laboratory has shown that patients with good tumor-specific immune responses show improved survival. We developed cancer-antigen specific chimeric antigen receptor (CAR) T-cell therapy and translated to a clinical trial. Keeping the regional aggressive nature of pleural mesothelioma with rare metastases, the CAR T cells are being delivered intrapleurally in our clinical trial. We also summarized the different methods of immunotherapy for malignant pleural mesothelioma - immune checkpoint blockade, immunotoxin therapy, anticancer vaccines, oncolytic viral therapy, and adoptive cell therapy as the most common and pertinent methods of immunotherapy currently being assessed in clinical trials. In addition to highlighting some of the successes of immunotherapy, we also have identified limitations that must be overcome to improve the efficacy of these therapies.

The Asbestos Paradigm in Unraveling the Mechanisms of Alveolar Epithelial Cell Mitochondrial DNA Damage: Implications for Lung Cancer

Dr. David W Kamp, Northwestern University Medical School, Chicago

Asbestos exposure remains an important cause of pulmonary fibrosis (asbestosis) and lung malignancies. Notably, patients with asbestosis, similar to idiopathic pulmonary fibrosis (IPF), have an increased risk for lung cancer. Alveolar type II (AT2) cell injury and apoptosis is evident in patients with asbestosis and IPF. Careful research by our group and others has begun to unravel the molecular events linking asbestos with the development of lung fibrosis that can be targeted for therapy. The ability of asbestos fibers to induce alveolar epithelial cell (AEC) injury and repair are critical determinants of their fibrogenic and, presumably, their malignant potential. We have shown that mitochondrial reactive oxygen species (mt-ROS) mediate asbestos-induced AEC DNA damage, endoplasmic reticulum (ER) stress, and apoptosis by a p53- and mitochondria-regulated (intrinsic) death pathway. Our group established a key role for a novel mechanism by which mitochondrial (mt)DNA base excision repair enzyme, 8-oxoguanine-DNA glycosylase 1 (mt-OGG1), prevents oxidant-induced AEC apoptosis by preserving mitochondrial aconitase (ACO-2) and preventing mtDNA damage. We showed increased asbestos-induced lung fibrosis in mice deficient in OGG1 ($Ogg1^{-/-}$) due in part to AT2 cell mtDNA damage, p53 expression, and intrinsic apoptosis while transgenic mice overexpressing mitochondrial catalase (*MCAT*) are protected from AEC mtDNA damage, apoptosis and lung fibrosis following asbestos exposure. Our more recent studies suggest that mice globally over-expressing mtOGG1 have reduced asbestos-induced lung mtDNA damage and lung fibrosis. SIRT3, the major mitochondrial NAD-dependent deacetylase with tumor suppressor functions, attenuates mt-ROS-induced mtDNA damage in part by deacetylating manganese superoxide dismutase (MnSOD) and mitochondrial 8-oxoguanine DNA glycosylase (OGG1). We recently reported that IPF lung AT2 cells have increased $MnSOD^{K68}$ acetylation compared to controls while oxidative stress (asbestos or H_2O_2) diminishes AEC SIRT3 protein expression and increased mitochondrial protein acetylation, including $MnSOD^{K68}$ and $OGG1^{K338/341}$. SIRT3-over-expression reduced oxidant-induced AEC $OGG1^{K338/341}$ acetylation, mtDNA damage and apoptosis whereas SIRT3 silencing promoted these effects. Asbestos- or bleomycin- induced lung fibrosis, AEC mtDNA damage and apoptosis in WT mice were amplified in $Sirt3^{-/-}$ mice. Collectively, these studies are informing our understanding of the mechanisms by which asbestos-induced AEC mtDNA damage promotes apoptosis and pulmonary fibrosis. We reason that AEC mtDNA is a key target that integrates cell survival / death signals following exposure to fibrogenic / carcinogenic agents, such as asbestos fibers. Importantly, the asbestos paradigm is providing insights into the pathophysiologic events of other lung diseases that may identify novel molecular approaches useful in preventing pulmonary fibrosis and/or lung cancer following exposure to environmental toxins (e.g. asbestos, cigarette smoke, particulate matter etc.).

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Erionite Carcinogenic Potency: Epidemiological Assessment and Toxicological Considerations
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Erionite had become known as "the most toxic mineral on the Earth" when mesothelioma mortality rates skyrocketed in Cappadochia, Turkey, where this zeolite rock was used as a building material. However, fibrous erionite can also be found in different locations in the United States (for example, in North Dakota, California, Oregon, and Nevada). Recently, a death from mesothelioma, apparently caused by erionite exposure, was reported in Mexico. In spite of significant toxicological concerns, erionite fibers are still not specifically regulated in the U.S. or internationally for workplace and ambient air permissible levels, or for transportation. This talk will explore approaches to a determination of erionite potency factors for mesothelioma. The data about air concentrations of PCME erionite fibers in Turkish villages will be juxtaposed with published mortality rates: for example, with mesothelioma mortality in a Swedish cohort of Karain emigrants. Monte Carlo simulation results show that erionite mesothelioma potency in terms of a Hodgson, Darnton RM metric has an average level of 3.46 (95 % CI 1.48, 7.13), approximately 7 times higher than for Australian crocidolite. It will be demonstrated that a similar estimation of erionite potency maximizes the F value of a predictive toxicological model deriving the mesothelioma potency from silicon/magnesium ratio, iron content, and the median dimensional characteristics of various fiber types. The presenter will compare this estimation of erionite potency with other published assumptions regarding carcinogenic potential of erionite in animal studies and epidemiological observations. The results of a new sampling and analysis of erionite-containing materials from Karain village in Turkey will also be presented. Various estimations of a potential occupational exposure limit (OEL) for erionite fibers will be compared and discussed.

Mysteries at the Biotic Interface

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Much work has been done to demonstrate human disease and characterize its epidemiology following exposure to elongated mineral particles (EMP). Yet, specific mechanisms involved in internal transport and toxicology of EMP leading to cancer and other health outcomes remain a matter of great concern. Recently, biophysical investigations into the nature of engineered nano- and micro-sized particles have expanded our understanding of particle-membrane physics. This presentation will explore particle behavior at the biotic interface with an eye toward advancing the biophysics and toxicology of EMP. The role of hydration shells, coulombic attraction, and particle dimension will be explored as important measures at the level of the cell membrane.

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MONDAY'S POSTER ABSTRACTS

Quantitative analysis of the role of fiber length on phagocytosis and inflammatory response by *alveolar macrophages*

Trudy Padmore, Carahline Stark, Julie Champion, and Leonid A. Turkevich
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Background: In the lung, macrophages attempt to engulf inhaled high aspect ratio pathogenic materials, secreting inflammatory molecules in the process. The inability of macrophages to remove these materials leads to chronic inflammation and disease. How the biophysical and biochemical mechanisms of these effects are influenced by fiber length remains undetermined. This study evaluates the role of fiber length on phagocytosis and molecular inflammatory responses to non-cytotoxic fibers, enabling development of quantitative length-based models.
Methods: Murine alveolar macrophages were exposed to long and short populations of JM-100 glass fibers, produced by successive sedimentation and repeated crushing, respectively. Interactions between fibers and macrophages were observed using time-lapse video microscopy, and quantified by flow cytometry. Inflammatory biomolecules (TNF-α, IL-1 α, COX-2, PGE2) were measured. Results: Uptake of short fibers occurred more readily than for long, but long fibers were more potent stimulators of inflammatory molecules. Stimulation resulted in dose- dependent secretion of inflammatory biomolecules but no cytotoxicity or strong ROS production. Linear cytokine dose- response curves evaluated with length-dependent potency models, using measured fiber length distributions, resulted in identification of critical fiber lengths that cause frustrated phagocytosis and increased inflammatory biomolecule production.
Conclusion: Short fibers played a minor role in the inflammatory response compared to long fibers. The critical lengths at which frustrated phagocytosis occurs can be quantified by fitting dose-response curves to fiber distribution data.
General Significance: The single physical parameter of length can be used to directly assess the contributions of length against other physicochemical fiber properties to disease endpoints.

Arizona Amphibole Asbestos Induces Autoimmunity and Fibrosis in Mice

Deborah Keil[1], Brenda Buck[2], Caleb Stair[1], Zoie Kaupish[1], Rodney Metcalf[2], Jean C. Pfau[1]
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Asbestos is a well-known carcinogen that contributes to autoimmunity and other health consequences. Libby Amphibole (LA) asbestos was a contaminant of vermiculite mined near Libby MT for decades, leading to asbestos diseases not only in mine workers, but in the entire community. Amphibole asbestos fibers in Arizona (AzA) have recently been discovered in the Lake Mead Recreational Area, but their health impact is unknown. The goal of this study was to determine whether these fibers, with similar chemistry to LA, induce autoimmune and fibrotic responses at a very low dosage that might represent environmental exposures. Seven months after exposure, blood, urine, diaphragms and lungs were collected from mice. Serum was used to determine autoantibody (ANA) levels and T helper cytokine responses. Urine was used to measure protein excretion, suggesting kidney involvement. Results revealed ANA levels were statistically significant with positive results with AzA. Urine analysis indicated significant amounts of excreted proteins by treated mice, consistent with an autoimmune process. Also, all three Th-17 cytokines were shown to have increased levels in treated mice that were statistically significant above controls. Analysis of lungs and diaphragms revealed significant interstitial and pleural fibrosis in the fiber-treated mice. Therefore, our results show that the AzA poses a serious health risk, even in small doses.

microRNA as Exosomal Biomarkers for Mesothelioma

Phillip B. Munson and Arti Shukla. Ph.D.

Malignant mesothelioma is a highly aggressive tumor directly associated with exposure to asbestos with median survival post-diagnosis of less than 1 year. Up to the present time, there are no useful means of diagnosing mesothelioma before the patient is experiencing symptoms of this invasive neoplasm, and it is effectively too late to meaningfully intervene. This lack of suitable detective biomarkers, taken with the fact that the mechanism of tumor development is mainly unknown, heralds the fact that more innovative approaches to understanding this disease are needed. Our lab is currently focusing on utilizing a novel approach to biomarker identification in the form of exosomes. Exosomes are small (40-140nm) membrane bound extracellular vesicles of endosomal origin that are currently a hot trend in scientific research for identifying unique biological disease signatures and uncovering the mechanistics of many vital processes of malignancy. We initially hypothesized that exosomes secreted from mesothelioma tumor cells carried a unique microRNA (miRNA) cargo compared to non-cancer cells. We uncovered that there is indeed a unique miRNA signature secreted in exosomes from mesothelioma cells, and more interestingly that a set of the significantly upregulated miRNAs happen to be tumor suppressive. At first, this appears counter-intuitive but led us to an altered hypothesis that mesothelioma tumor cells preferentially secrete tumor suppressor miRNAs in order to avoid the deleterious effects they may have on the tumor's progression. This study currently focuses on miR-16-5p, and provides evidence that this tumor suppressor miRNA is secreted significantly more from tumor cells than non-cancerous cells, and that cancer cells themselves have less of this miRNA expressed within the producer cells when compared to their non-cancerous counterparts. This work is supported by funding from DoD W81XWH-13-PRCRP-IA and NIH RO1 ES021110 grants.

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Abstracts for Tuesday Morning, August 1, 2017

SESSION 2: GEOLOGY

Towards a Training Program for Geologists and Other Asbestos Professionals Working on NOA Projects

(R. Mark Bailey, PG – Asbestos TEM Labs & Bradley Erskine, PG, CEG, CAC – Kleinfelder)

CIHs, CACs, SSTs and other professionals in the field of dealing with asbestos hazards have specific required course training for ACBM, but no such training exists for situations involving NOA. And geologists, the players who are often on the front lines in dealing with NOA sites and who are called on to assess site geology, sample rock and soil for the presence of asbestos, and to interpret the mineralogy found in bulk and air samples from a given site, also have virtually no training in NOA issues. A need has been identified for training of a similar type to that for ACBM inspectors, site surveillance technicians and project managers for people dealing with NOA sites. A discussion of the proposed items to be included in an NOA training course will be discussed.

NOA at the Calaveras Dam Replacement Project: A Status Report

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The Calaveras Dam Replacement Project (CDRP) has just completed the excavation phase (7 million yards of material), and is now beginning the construction phase (3 million tons of fibrous amphiboles). The data set for this phase consists of 5.5 years of data with more than 17,000 samples from 13 stations analyzed by CARB/AHERA TEM. Special studies, including the analysis of airborne dust reduction systems, chrysotile in reservoir water used for dust suppression, mineralogical and fiber-size and dimensional analysis of each rock type on site, testing for asbestos on leaves and duff for re-entrainment analysis, and other studies have been completed for the documentation and defense of the project. This presentation will summarize the status of the project focusing on emissions from each of the disturbance activities, methods to project emissions to the end of the project and its use as a tool for emissions and risk management, attempts to correlate fiber concentration and dimensions with personal exposure, and compositional (fingerprinting) analysis for onsite and off-site source differentiation.

Conceptual Model for Surficial Redistribution of Naturally Occurring Asbestos in Arid and Semi-arid Landscapes: Case Study in Southern Nevada, USA.

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Abstract (will wrap and grow): Naturally occurring amphibole asbestos has been found in rock, soil and dust in both urban and rural areas of southern Nevada and northwestern Arizona. The asbestos is sourced from plutonic rocks with fibrous Ca-amphiboles occurring primarily in Nevada (actinolite), and Na-amphiboles occurring primarily in northwestern Arizona (winchite, magnesioriebeckite, richterite). However, few studies have been performed to understand how surficial processes distribute these fibers and how these processes affect concentration and fiber morphology in soils and unconsolidated sediments. We have developed a conceptual model for naturally occurring asbestos distribution in arid and semi-arid landscapes based on known soil and surficial processes. To test this model, we have collected preliminary data through a combination of methods including scanning electron microscope-energy dispersive spectroscopy; wavelength dispersive electron probe microanalysis; polarizing light microscopy, and transmission electron microscopy on samples prepared with the fluidized bed asbestos segregator. These data indicate that both alluvial and eolian processes significantly contribute to the distribution of asbestos across the landscape. Although both alluvial and eolian processes operate over geologically long time periods, alluvial processes are significantly easier to model because water is constrained to flow downhill. In contrast, eolian processes are highly variable in both time and space, and have complex interacting factors such as climate, soil moisture, vegetation and anthropogenic processes that make predictions much more difficult. However, preliminary data supports our hypothesis that asbestos is concentrated in vesicular soil horizons as a result of eolian processes. We find that both alluvial and eolian processes have resulted in a wide distribution of naturally occurring asbestos across the landscape in southern Nevada, which increases the potential for human exposure. Although more research is needed to test the details of our conceptual model, this type of information is very useful for land use planning that seeks to decrease human exposure.

Conceptual Model for Surficial Redistribution of Naturally Occurring Asbestos in Arid and Semi-arid Landscapes: Case Study in Southern Nevada, USA.

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Update on erionite

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Erionite occurs in volcaniclastic rocks and soils; in some villages in Turkey the presence of erionite in local rocks is associated with mesothelioma, a disease also associated with inhalation of airborne asbestos. Since volcaniclastic rocks containing erionite are widely present in the western USA, there is a concern over potential health issues following inhalation of dust particles in these areas and thus there is a need to identify and quantify erionite particles found in air samples during hygienic investigations. Previous attempts to analyze the few micrometer-sized erionite particles found on air sample filters under transmission electron microscope (TEM) encountered difficulties due to electron beam damage. Recommendations are presented for accurate analysis by both energy-dispersive spectroscopy (EDS) and selected area electron diffraction (SAED). Much of the work previously published to establish the crystal chemistry of erionite has involved the relatively large crystals found in vesicles in extrusive volcanic rocks. Analysis of these crystals gives a weight percent ratio of Si to Al in a narrow range around 2.7 (molar ratio 2.6), consistent with a unit cell formula $Al_{10}Si_{26}$. In addition, the cation contents of these crystals generally meet the charge balance error formula for zeolites. However, erionites formed in volcaniclastic sedimentary rocks (tuffs) have very different Si:Al weight percent ratios, around 4.0, which is above the upper range for the analyses of the crystals found in vesicles. Analysis of many particles in samples from different locations reveal two other major differences between the erionites from the sedimentary situations and those found in vesicles. 1) The extra-framework alkali cation (Na, K, Ca) contents are lower than required for a stoichiometric balance with framework Al substitution for Si so that the cation charge balance error formula limits for zeolites are not met. 2) There is a large variability in measured cation contents from particle to particle from the same source as well as substantial differences in average compositions from different sources. However, sedimentary erionites cannot be termed a separate mineral species because the crystallographic data are consistent with erionite and new zeolite names cannot be proposed on the basis of Si:Al ratios alone. In addition to chemical differences between erionite from different sources, there are also morphological differences. By analogy with asbestos minerals, differences in composition and morphology may have implications for relative toxicity, and future research should include consideration of these aspects.

Erionite Analysis by TEM

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Erionite is a naturally occurring fibrous mineral that belongs to the zeolite group of hydrated aluminosilicates. Presently, erionite is mostly found as an environmental contaminate; having not been mined or marketed for commercial purposes since the late 1980's. Similar to asbestos, it is a naturally occurring mineral that has been designated by IARC as a Group 1 Carcinogen. Since 1985, the analytical transmission electron microscope (TEM) has been the instrument of choice for asbestos analysis in the United States because it is equipped with both an X-ray analyzer (TEM EDS) and camera system for diffraction image capture, which when combined are capable of quickly determining the crystal structure and chemistry of mineral fibers. Erionite has a very distinctive selected area electron diffraction (SAED) pattern which makes it an ideal candidate for identification by TEM. However, unlike asbestos, it is extremely sensitive to the high energy of the electron beam. The beam's intensity has been shown to volatilize sodium and potassium and rapidly decay the crystal lattice. Under normal TEM operating conditions, the diagnostic diffraction pattern usually lasts for less than 10 seconds before the diffraction spots fade as the cumulative beam dose increases, which is not sufficient time for an analyst to image the pattern for crystal indexing. Additionally, these specimen and beam interactions also have a compound effect on fiber reanalysis for quality control (QC), because the fiber has been destroyed to the point of being unrecognizable to a second analyst. Another challenging aspect of erionite analysis is that it has extremely variable chemistry due to the intergrowth between erionite and another mineral, offretite, which means that intermediate chemical compositions can be expected. Most published erionite identification and characterization papers rely heavily on bulk sample quantitative chemistry by either ICP-MS or EPMA. However, these instruments require a larger sample size than is typically collected on the filter membrane of an air sample and chemistry alone cannot readily distinguish between offretite and erionite, unlike diffraction. With a small change to the asbestos analysis protocol, we have tested a reproducible analytical procedure for rapid identification of erionite fibers in Air, Bulk and Soil samples by TEM. With this approach we have been able to acquire and preserve SAED patterns from several different sources of Erionite, diminish the degradation caused by the electron beam and ensure the fiber is still viable for QC analysis. This new technique will allow commercial analytical laboratories to contribute to air exposure studies and characterization guidelines which may help in determining regulation and further our understanding of the health risk associate with erionite.

Notes: Erionite from Oregon, South Dakota, North Dakota, Turkey, and Arizona have been used.

Two Modes of Fibrous Growth Habit in Amphiboles

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The prevailing view among many asbestos experts is that genesis of fibrous (asbestiform) amphibole requires growth into open spaces and/or growth during shearing. This rationale is used to argue the amphibole asbestos (AA) is rare in rocks and soils. Here we report on occurrences of fibrous NaFe+3-amphibole (winchite and magnesioriebeckite) and actinolite that formed by low temperature (<400°C) hydrothermal alteration during faulting of Miocene granite plutons (Nevada-Arizona). Two major modes of AA are present in these plutons (1) monomineralic open fracture fill veins (slip-fibers) which we interpret as primary precipitation of AA from hydrothermal solution, and (2) pseudomorphic replacement of magmatic Mg-hornblende. Such replacement of non-fibrous Mg-hornblende by AA is a clear example of fibrous amphibole growth in the absence of open space and without internal shearing. To test whether these two growth mechanisms produce similar fiber morphologies, we micro-sampled primary and secondary AA particles, and imaged and measured particle chemistry and dimensions using SEM. Imaged particles were classified as fibers, fiber bundles, or prismatic crystals (cleavage); both primary and secondary sample sets included significant populations of all three particle types. For fiber subpopulations length (L), width (W), and aspect ratio (AR) of primary fibers (L = 18, W = 0.7, AR = 22) and secondary fibers (L = 12, W = 0.8, AR = 15) are comparable. Pseudomorphic replacement of non-fibrous Mg-hornblende by fibrous amphibole requires mineral dissolution-reprecipitation and exchange of ions between amphibole and fluid. This process drove the fluid to super-saturation with respect amphibole resulting in fluids capable of direct precipitation of fibrous AA in fracture fill veins. Our results suggest that (1) hydrothermally alteration of common hornblende-bearing granitic rock is a potential AA source, and (2) fibrous habit in amphibole does not require growth in open space or internal shear.

Two Modes of Fibrous Growth Habit in Amphiboles (continued authors)	
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Proposal of a partition in the diagram Si vs. Mg / Mg + Fe, taking into account all calcic asbestiform amphiboles.	
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It is necessary that tests laboratories and geologists have a common reference for the characterization of calcic asbestiform amphibole. The proposed diagram is based on EDS chemical analysis and morphological observations, it was established with data from the two professions.	

The chemical composition of asbestiform fibers of samples, coming from bodies of the metropolitan France and analyzed with SEM equipped with EDS by geologists and chemical composition of fibers classified as asbestiform from aggregates and rocks collected in France and in New Caledonia, routinely analysed with a TEM equipped with EDS by a test laboratory specialized in research of asbestos, covers the same compositional field in the Si apfu vs. Mg / Mg + Fe apfu diagram. This field is wider than that of tremolite and actinolite defined by the IMA 12 and EPA. The difference between the measurement uncertainties of the EDS versus the microprobe is not enough to explain this overrun.
Taking into account data, we propose to keep the fields of tremolite and actinolite as defined by IMA12 and to create two new fields called "actinolitic asbestos or AA" and "undifferentiated calcic asbestos or UCA" covering part of the field of the magnesio-hornblend, part of the Ferro-hornblend and part of the Ferro-actinolite of the IMA12 partition.
The preparation and analysis made by geologists introduce, not too much disturbances, in situ morphology of fibers can be observed. From geological data we have defined a covered area to 99% by calcic asbestiform amphiboles CAA which breaks down into four fields: 67% actinolite fibers, 2% tremolite, 21% "actinolitic asbestos" and 10% "undifferentiated calcic asbestos". Acicular Amphiboles cover 89% of the compositional field defined for all Calcic Asbestiform Amphiboles CAA, the prismatic amphiboles covers only 64% of CAA.
We tested this diagram Si vs. Mg / Mg + Fe with samples analyzed routinely by a tests laboratory specialized in the research of natural asbestos. After grinding, 100% of the fibers, classified as asbestiform, having a ratio of 1/20 and with a width less than 3µ, 100% of the fibers classified as asbestiform, as showing density contrasts (Langer type) and 100% of the fibers having an aspect ratio 1/3, a length greater than 5µ and a width less than 3µ (WHO) including cleavage fragments in addition to the asbestos fibers, cover the compositional field of CAA, defined above . The percentage of AA fiber and tremolite are comparable, the percentage of actinolite is more important and the percentage of UCA fibers is much less.

(Continued from previous page) The toxicity of AA and UCA is not known, but it is hard to think that it will be less than that of tremolite and actinolite asbestos only because they are in adjacent compositional fields traced by convention by geologists. The toxicity of calcic asbestos amphiboles need to be tested.

The fact, that all the "WHO" fibers are in the compositional field of CAA shows that all calcic amphiboles have not the capacity, after grinding, to produce cleavage fragments with WHO dimensions. It is possible that a large part is produced by acicular amphiboles given the fact that in this study, most acicular amphibolites are in the compositional field of CAA. This is consistent with the observations of Germine (1986).

Additional XRD and pre-concentration developmental work on the determination and characterization of erionite and other zeolites in support of ASTM Work Item, WK 39550, PLM Analysis of Soils and Gravels and NIOSH (Martin Harper) evaluations for erionite by PLM, Microprobe, and TEM analyses.

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Abstract (will wrap and grow): From previous studies (Lou Solebello, Gary Tomaino), it was shown that XRD analysis to be an effective technique in confirming or denying stated zeolite type and source in conjunction with PLM standards/reference evaluations while more recent work presented at the 2015 ASTM D22.07 NOA Conference discussed the detection of erionite at the 1% level by XRD and the use of high precision sieving to concentrate erionite/zeolites to lower the detection limit to below 0.5%. This work will expand upon the feasibility of lower the erionite detection limit to below 0.1% using the high precision sieving and confirmation by XRD. Additional work on preparation and characterization of given concentrates for potential reference materials will also be discussed for Rome-Oregon, Arikaree-South Dakota sources with additional work presented on Killdeer-South Dakota, Woolly erionite-Nevada, and Capadoccia-Karain/Turkey sources.

Using stable O and H isotope ratios to constrain conditions of talc formation in Southwest Montana and other economically significant locations

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Abstract (will wrap and grow): Stable O and H isotope ratios are commonly used to understand the histories of hydrothermally altered minerals. Hydrothermal fluids are involved in varying degrees in the formation of economic talc deposits. We analyzed talc samples from locations worldwide in order to compositionally characterize both current and past economic talc deposits and found that ores from some deposits have very similar compositions based on major and trace element concentrations, acquired by electron microprobe and bulk x-ray fluorescence spectroscopy analyses. Consequently, we explored the possibility that ores may be distinguished based on stable isotope ratios. The talc samples in this study are from the Murphy marble belt in North Carolina, southwest Montana, northwest Death Valley region in California, Vermont, the Van Horn deposits in west Texas, and Germanasca Valley in northern Italy. The deposits in North Carolina, Montana, and Italy are known sources of talc for a body powder product, which has been the focus of asbestos litigation. Secondly, the very pure talc deposits in Montana were suggested to not only be genetically unrelated across the region, but to also be a result of hydrothermal alteration associated with a much younger event than previously determined. We expected the paired H and O isotope ratios for these talcs to create unique clusters when plotted against temperature that directly relate to the composition of the altering fluids in each of these geologic environments. Generally, talc H and O isotope ratios cluster for the entire talc-mining region in southwest Montana, and overlap with those acquired in earlier studies of the area indicating that the region experienced a unified geologic history, not associated with the aforementioned earlier event.

Mineralogical resources for those dealing with respirable mineral dust

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I would like to use my talk at this Johnson Conference to present readily available, validated material to this community that I think will be useful for such things as mineral nomenclature, mineral identification, and gaining a better understanding of the science of mineralogy. I base the "useful" part on the many, many requests I get from those working in the subject matter covered at this conference that most often can be easily addressed by referring to several of the sources I will briefly describe. In general, these resources are based upon mineralogical research and teaching methods developed in the academic environment over the past 100-200 years, and made available at low- to no-cost as they are provided by the not-for-profit mineralogical societies world-wide.

First off is the Mineralogical Society of America (MSA) (www.minsocam.org) which was formed in 1919. One of the major goals of this society is the dissemination of mineralogical research through several publications, starting with the American Mineralogist (www.msapubs.org) first published in 1916; much of the original research on minerals is found in this journal. All the issues from 1916 to 2000 can be downloaded for free, while membership is required for 2001 forward. Next is Reviews in Mineralogy and Geochemistry now 81 volumes strong, as the implies each volume presents a review of either mineral groups (e.g., amphiboles, zeolites, etc.), mineralogical techniques (e.g., TEM, XRD, spectroscopy, etc.) or subjects (e.g., health effect of mineral dust, medical mineralogy and geochemistry, mathematical crystallography, etc.). These volumes are typically 500-600 pages and cost from $36 to $50. Hardcopies can be ordered from (msa.minsocam.org/publications.html) or electronic copies of individual chapters obtained from (www.minpubs.org). Finally mineralogical textbooks, including the classic books of Don Bloss and a DVD-animated textbook by Dyar & Gunter (2008) – recently turned into a series of iBooks (www.minsocam.org/msa/DGTtxt/) are also available from MSA. (For full disclosure I receive $5 royalty for each sale of this book, so if you buy the book, please send me a self-addressed envelope and I'll send you a $5 bill as my goal is to provide information and not make money.)

The only commercial product I'll mention is CrystalMaker which is a suite of programs for drawing crystal structures as well as simulating both powder X-ray and single crystal diffraction (www.crystalmaker.com), thus it can simulate electron diffraction patterns of minerals in different orientations. We used this software extensity in our textbook. While the software comes with several mineral input files, many more mineral structures can be found and freely downloaded from the American Mineralogist crystal structure database (www.minsocam.org/msa/Crystal_Database.html), and are included on our books DVD. Another similar database (rruff.info) provides compositional, powder X-ray diffraction, IR and Raman spectra for many minerals from several locales. The database is so "fampus" it even has a mineral named after it – rruffite. And for a "laugh," assuming you like cats and Apple, Google on "rruffite mineral mindat" where you will find the derivation of the name "rruff" and one of the best on-line mineral databases (www.mindat.org).

The Mineralogical Association of Canada (www.mineralogicalassociation.ca) and The Mineral Society (www.minersoc.org) founded in 1876 provides many similar resources as does MSA, but with more of a Canadian and European twist. The Geological Society (www.geolsoc.org.uk/index) is the oldest of the societies I'll mention founded in 1807. And most importantly to the mineralogical community publishes what we often refer to simply as "DHZ," which is short for Deer, Howie, and Zussman the last names of three authors who published a five volume mineral reference set (total book shelf width of 6") in 1963, which has now been revised to an 11 volume set (total book shelf width of 17"), which can be obtained from (https://www.geolsoc.org.uk/RFMSET11). I think it's well worth the cost of 1,064 pounds!

Finally I'd like to mention the International Mineralogical Association (IMA) (www.ima-mineralogy.org). This is official international group that is the "keeper" of such things as the currently accredited mineral species (nrmima.nrm.se), as well as the accepted nomenclature for mineral groups (nrmima.nrm.se//imareport.htm), where one can find, for example, how the species of amphiboles and zeolites are classified and named.

Johnson Conference 2017

Abstracts for Tuesday Afternoon, August 1, 2017

SESSION 3: REGULATORY PERSPECTIVES

ASTM E2356-14 "Standard Practice for Comprehensive Building Asbestos Surveys" - The Application to Industry

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This session will be a general explanation of E-2356-14 including the three types of asbestos surveys defined in the standard; Baseline Survey, Pre-construction Survey and Project Design Survey. An emphasis will be placed on the practical application of the standard for common uses with an emphasis on the USEPA requirements for compliance for a "thorough" asbestos survey prior to demolition and/or renovation activities. The discussion will include an explanation of a clarification letter from USEPA allowing the use of the E2356-14 "Pre-construction Survey" for asbestos NESHAP compliance. The session will be of specific interest to asbestos regulators, building owners/managers, asbestos consultants and others.

Asbestos at the source: understanding the differences between regulated commercial asbestos, asbestiform minerals in rocks, and false positives

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Since the public health situation in Libby, Montana, became a major issue nearly twenty years ago, interest has grown in the occurrences of asbestiform minerals in situ. Many people are not aware that asbestos is refined directly from minerals that form in geologic settings, rather than being a synthetic material. Many analysts understand that asbestos products are derived from minerals, but do not have the context to understand these minerals in their geologic settings. This presentation will discuss the relevant factors of growth habits versus cleavage habits, interpreting apparent fibrous minerals in thin sections, the use and misuse of terms such as "fiber" and "acicular," and confusion regarding the three species of erionite. Examples will avoid complex terminology and esoteric mineralogy, and instead will be easy to understand for the lay person or anyone without a background in mineralogy.

Avoiding 1%? Analytical Mindfulness and Statistical Monitoring

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The ever evolving ability of LIMS, and other such databases, that have been used to cull through lab results data for everything from instrument calibrations, QA reanalysis compliance, laboratory and individual analyst monitoring, etc., may still not be sufficient to prevent negligence and fraud. For laboratories engaged in bulk building material analysis by light and electron micrsoscopy methods, the quality of the data may not match the integrity of the data. One such phenomenon that is often a benign source of data manipulation at the analyst level has to do with the distribution of 1.0% (either by point counting or by CVAE) as a result. This brief presentation will...

- center around this pattern of 'avoiding' 1.0%,
- how this was discovered over the last thirty years of data review,
- how recent accounting/auditing models are used to look for data distributions,
- how game theory algorithms are employed to monitor for fraud,
- how this can be applied to asbestos analysis by Polarized Light Microscopy,
- and how Laboratory Training Programs can include such elements to promote best practices.

Finalizing the Libby Action Plan Research Program	
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Libby, Montana is the location of a former vermiculite mine that operated from 1923 to 1990. The vermiculite ore from the mine co-existed with amphibole asbestos, referred to as Libby Amphibole Asbestos (LAA). Combined with the cessation of the asbestos mining and processing operations, there has been significant progress in reducing the exposure to LAA in Libby, Montana. In 2009, the U.S Environmental Protection Agency (EPA) jointly with the Department of Health and Human Services (DHHS) declared a public health emergency in Libby due to observed asbestos-related health effects in the region. As part of this effort, the EPA led a cross-agency research program that conducted analytical, toxicological, and epidemiological research on the health effects of asbestos at the Libby Asbestos Superfund Site (Libby Site) in Libby, Montana. The Libby Action Plan (LAP) was initiated in 2007 to support the site-specific risk assessment for the Libby Site. The goal of the LAP research program was to explore the health effects of LAA, and determine toxicity information specific to LAA in order to accurately inform a human health risk assessment at the Libby Site. LAP research informed data gaps related to the health effects of exposure to LAA, particularly related to specific mechanisms of fiber dosimetry and toxicity (e.g., inflammatory responses), as well as investigated disease progression in exposed populations and advanced asbestos analytical techniques. This work included the derivation of a LAA-specific Inhalation Unit Risk (IUR) for cancer risk evaluation and Reference Concentration (RfC), the latter being the first non-cancer risk estimate for any form of asbestos. The research sponsored under this plan has been, and continues to be, used to support the site-specific assessment and cleanup work at Libby and Libby daughter sites. The sponsored research has also made invaluable contributions to our understanding of the health risks posed by amphibole asbestos..DISCLAIMER: The views expressed in this commentary are those of the authors and do not necessarily represent the views and/or policies of the U.S. Environmental Protection Agency.

Finalizing the Libby Action Plan Research Program (continued authors)	
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State Asbestos Regulations Between the Lines: What is the nature of enforcement?

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Thirty years ago keeping up with asbestos industry regulatory compliance meant tracking changes in regulation. There have been relatively few regulatory updates in recent years, so the new question becomes how the written rules are enforced in the field. The political climate in some jurisdictions has created staff reductions and deemphasis on enforcement; in others enforcement has kept pace or even been stepped up. This presentation will look at diverse examples of asbestos regulation in states in at least 6 EPA Regions. Which agencies are taking the lead in asbestos enforcement, Environment, Health, OSHA, or other entities such as localities? What level of staffing is dedicated to enforcement? What are the key interpretations that shape the scope of application? How does enforcement activity impact contractors and consultants? The result of this analysis should begin to reveal the diverse regulatory cultures in the United States. For practitioners, key questions that must be answered to evaluate the regulatory culture before entering into a new jurisdiction will be illustrated.

Rainbows and colored pencil drawings: the fallacy of determining a numeric refractive index from dispersion staining colors

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For quite some time, NVLAP has required that asbestos labs report a numeric refractive index (RI), carried to two decimal places, when bulk asbestos species are detected in a sample. Recently, AIHA has instituted the same requirement. However, the determination of a quantitative RI by using dispersion staining is a subjective, rather than objective, endeavor. The dispersion colors can vary depending upon the light source, the optics, and the configuration of the microscope. Color perception can also vary by individual. In addition, asbestos products can be altered by heat and chemical treatments, causing a change in dispersion colors. This presentation will explore the challenges in translating the subjective perception of color into a numeric RI, and question whether this should be required at all. The reported numeric RIs from several different analysts observing the same sample will be compared, noting the variations in each, and these values will be compared to the actual RI for each sample as determined by the Becke line method. Finally, we will consider the words of Walter McCrone, author of the method, who felt that reporting numeric RI values was no more accurate or useful than reporting the colors directly.

Peggy Forney: USEPA National Enforcement Investigative Center Career Achievement

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Recently retired from USEPA, Peggy Forney, with the unassuming title of "Chemist", was more like the lead investigator from any CSI drama ever broadcast. This presentation outlines the twists, turns, and drama of her several ASTM International presentations delivered at Johnson and Beard Conferences from 2005, 2008, 2010, 2011, 2013, and 2016.

Presentation may embed a short video

Title of Presentation: **Point Counting is Causing Asbestos Deaths**	Preferred Presentation: ☒ Oral ☐ Poster
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Abstract (will wrap and grow): **People will be dying 30 years from now due to the widespread practice of "point counting down" PLM bulk samples. It is always "point counting down," never "point counting up."**

At a high rise office building in Los Angeles built in 1975, we found asbestos in drywall joint compound on several floors. All of the bulk samples were reported to contain less than 1% asbestos by PLM analysis.

We designed a negative exposure assessment. A licensed asbestos abatement contractor built a negative pressure containment to perform dry removal of drywall, simulating what would happen in normal demolition work. The new owners hired another consulting company to also run air samples during the negative exposure assessment, as they thought they had purchased an asbestos-free building. We were lead consultant, with all analysis at the same laboratory. Eleven of the thirty air samples were readable by the laboratory, with Transmission Electron Microscope analysis showing an average of 0.25 asbestos structures/fibers per cc of air.

We collected 20 bulk samples of the drywall joint compound which had just been demolished. PLM point counting (400 points), for a total of 8,000 points, showed just one asbestos fiber on a point, and 5 off point. The correlation between the air sample results and the point counting results was very low.
Point counting is routinely used to allow demolition without training, respirators and engineering controls. There is no cost justification for using 400 or 1,000 point counting, as the price is the same or more than that for Transmission Electron Microscope re-analysis. It is being so that contractors who bid to perform abatement can avoid doing it, and to allow owners to avoid the cost of abatement.

We need to ban PLM point counting for asbestos surveys.

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TUESDAY'S POSTER ABSTRACT

A Tale of Two Quarries

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Although asbestos is no longer mined in the us, asbestos is still shoveled from the earth, processed, and sold under many guises. Having made that statement, many Johnson Conference attendees would immediately think I was referring to asbestos as a contamination of other resources, such as vermiculite or talc (as we have spent a good deal of our time and efforts on those two especially, and the potential for inclusion of asbestos now well-recognized).But for this talk, the asbestos being mined to be discussed is the very host rock itself of most of the asbestos in the world: Serpentinite. You may remember me talking at previous conferences about ornamental stone and detection of asbestos in such, but here I will focus on two case studies where serpentine deposits are currently being mined intentionally for use as gravel; one on the left coast in California, and the other in Maryland and Pennsylvania. In both quarries, rocks containing both chrysotile and asbestiform amphiboles have been repeatedly found. Further, exposure to dust from the resulting gravel has been attributed to mesothelioma causes: rock truck drivers afflicted in the east, and end-users of somewhat surprising occupations and exposure paths from the gravel in the west. I have been to both quarries and will provide 1st-hand accounts and photographic confirmation of asbestos in both open quarries, as well as present previous geological and EPA studies relevant to the sites. EPA studies confirm my own findings where gravel from the plaintiffs is consistent with rock from the quarries, and has proven capable of releasing airborne asbestos, both amphibole and chrysotile varieties. Also, ASTM sampling and dust sample protocols were implemented to correlate source-rock asbestos and other mineral particulate.

Johnson Conference 2017

Abstracts for Wednesday, August 2, 2017

SESSION 4: DEVELOPING ANALYTICAL METHODS

Challenges of Reconciling Two Asbestos Testing Laboratories' Analytical Results on an NOA Job Site with Complicated Amphibole Mineralogy

R. Mark Bailey – Asbestos TEM Labs, PG & John Harris – LabCor

The Calaveras Dam Replacement Project is situated in a geologic environment which contains a wide range of asbestos minerals, particularly amphibole asbestos. Two labs, Asbestos TEM Labs and LabCor, were tasked with providing analytical results for air samples taken at the site. During review of test results, it became apparent that different criteria were being used by each lab in their interpretation of EDX data collected on various identified asbestos structures leading to the assignment of different amphibole mineralogy. The two labs worked together to identify the sources of the disagreements and to find a means of reconciliation. The outcome of this process will be discussed with a conclusion stated and recommendations for how to avoid and/or resolve such conflicts on future NOA projects.

ASTM Dust Methods: The Effects of the Ultrasonic Preparation Technique on Asbestos Concentration, How to interpret the results.

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The ASTM D5755 and the D6480 asbestos in dust methods are the most utilized of the three ASTM dust methods. Samples are indirectly prepared and the final result is reported in structures per square centimeter. These methods have ultrasonic preparation steps that have the potential to disassociate complex asbestos structures into simpler structures, thereby elevating the reported asbestos fiber structure count, especially for chrysotile. Utilizing a glove box, asbestos containing materials were agitated to generate a surface dust deposit. Side by side samples of the dust were collected using the D5755 vacuum method. The samples were prepared with and without the ultrasonic step. The structures were counted and the mass of asbestos was calculated for each set of prepared samples. The effects, if any, of the ultrasonic step on fiber structure counts compared to the samples without ultrasonic treatment will be compared. Asbestos surface dust has the potential for re-entrainment into the air allowing for airborne concentrations of asbestos fibers. The methods developed by ASTM are not intended to be compared to occupational exposure limits nor are there health-based standards for surface contamination of asbestos. Methods for evaluating the surface loading of asbestos dust should be carefully studied and used when determining the potential for airborne re-entrainment and human exposure.

Pharmaceutical and Cosmetic Talc: XRD methodology and statistics for identification, detection limits and limits of quantification for total amphibole and total serpentine in support of ASTM WK 30352 and 2015-2020 USP Expert Talc Panel –Test Methods.

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This is the fourth update for the XRD portion of a proposed tiered methodology evaluation for Cosmetic and Pharmaceutical Talc matrices updates under ASTM Work Item, WK30352, and parallels equivalent XRD work under the 2015-2020 USP Expert Talc Panel-Test Methodologies. The update will cover additional work on 1) XRD instrument alignment and certified reference materials 2) talc identification and reference materials 3) limit of detection and limit of quantification for amphibole and serpentines and 4) a procedure to lower the bulk talc material detection limit down to 0.01% without pre-concentration steps using a sequential method of additions of amphibole and/or serpentine.

Fluidized Bed Asbestos Segregator – Inter-laboratory round robin

Jed Januch, David Berry, Lynn Woodbury

EPA continues to develop and evaluate the Fluidized Bed Asbestos Segregator (FBAS) as a tool to help detect low concentrations of mineral fibers in soil and other solid materials, such as vermiculite insulation. The FBAS utilizes air elutriation to separate light structures such as asbestos from heavier matrix particles and deposits the structures onto a filter, which may be analyzed by transmission electron microscopy (TEM) or other appropriate microscopic technique. EPA is now working toward validation of the method by demonstrating the method reproducibility between three FBAS preparation laboratories. Performance evaluation (PE) soil standards were prepared that range from 0.01% to 0.0005% concentrations of three asbestos types, including chrysotile, amosite, and Libby amphibole asbestos. In this study, three FBAS preparation laboratories prepared replicate filters of each PE standard. The majority were examined by a single analyst at one analytical laboratory. The results of this study reveal good reproducibility between the three FBAS sample preparation laboratories and reported soil concentrations show a linear correlation with nominal levels in the PE standards.

Update on New Methods for Asbestos in Pharmaceutical Grade Talc

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In 2009, it was reported that off-the-shelf personal care products with talc as a component in Korea and China contained asbestos. In November 2010, the U.S. Food and Drug Administration issued a request to the United States Pharmacopeial Convention (USP) to consider the issue and revise the labeling statement in the USP Talc monograph, and to consider revising the current tests for asbestos to ensure adequate specificity. In response, USP formed a panel of experts from industry, academia, and government, which reported to the USP Excipients Expert Committee. The Panel prepared a Stimuli to the Revision Process article: Block, L.H., Beckers, D., Ferret, J., Meeker, G., Miller, A., Osterberg, R., Patil, D., Pier, J., Riseman, S., Rutstein, M., Tomaino, G., Van Orden, D., Webber, J., Medwid, J., Wolfgang, S., and Moore, K., 2014, Modernization of Asbestos Testing in USP Talc Stimuli to the Revision Process, USP, online at www.usppf.com/pf/pub/data/v404/GEN_STIMULI_404_s201184.xml (one-time, free registration required to view article)

USP then formed a second panel to recommend revisions to the USP Talc Monograph with respect to labeling, as well as up to date methods to replace the current set of tests related to "Absence of Asbestos" in the monograph. The working scope of materials to be evaluated (and this is not a definition of "asbestos", per se) is as follows: USP Absence of Asbestos Scope- For the purpose of the USP Absence of Asbestos method, the definition of asbestos will include the six regulated asbestos minerals, and in addition, other asbestiform amphiboles with a focus on those known to cause asbestos-related disease. The regulated asbestos minerals include one serpentine group minerals (i.e., chrysotile) and five amphiboles (amosite, crocidolite, actinolite-asbestos, tremolite-asbestos, and anthophyllite-asbestos). The second panel is currently evaluating the analytical methods deemed necessary to satisfy the adopted scope. The end goal is to derive a workable set of analytical procedures based on scientific principles that will satisfy the FDA request to USP to protect consumers; and allow talc suppliers to ensure that talc products used in medicines are not harmful to human health. Progress on the updated method will be presented.

Concentration methods improve detection limits for the analysis of talc for asbestos

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Concentration techniques are the key to detecting trace levels of any analyte, including adverse minerals (i.e. asbestos) in talc. Methods successfully employed to concentrate asbestos in other mineral powders include acid dissolution (carbonates), float/sink method (vermiculite), and acid digestion (as per Addison-Davies). Unfortunately, due to talc's inert nature, chemical treatment using acids are completely ineffective. Research in this presentation shows that it is possible to concentrate asbestos, if present in talc, based on the very property that makes it asbestos, i.e. its high tensile strength. This property is all too elusive (cannot be measured) when employing microscopic methods which only measure single particle dimensions. It is however, easy to capitalize on this property by grinding and wet sieving prior to analysis. Here's how it works: talc is the softest mineral known and grinds very easily. Asbestos is resistant to grinding due to its high tensile strength (not to mention the fact that amphibole and serpentine are much harder minerals, Mohs 4 - 6 vs. Mohs 1). Due to the softness of talc, the more it is ground (milled), the more it separates from harder to grind components present (we see this with quartz, mica, feldspar, and any number of components that are harder to grind than talc. IF asbestos is present, the more the mixture is ground, the more the asbestos separates itself and concentrates in the larger size fraction. It becomes easy then, to separate these components using the simplest of lab instruments, a hand-held sieve. And, it is an easy process to then analyze the collected larger particles using techniques that do not involve sometimes uncertain complex interpretations, namely the traditional EPA 600/R-93/116 PLM method. Further, an added advantage of this type of analysis is that more particles contribute to the statistical "population," which is important in definitive asbestos characterization. This is a completely different approach than techniques that focus on looking for the smallest of particles, such as TEM. Research presented will compare techniques that look at the larger particles in talc spiked with trace amounts of asbestos vs. the smaller particles. This technique is currently validated at 100 ppm.

Effectiveness of PLM for the analysis of chrysotile asbestos spiked into talc

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Research has been presented that asbestos, if present in finely milled talc product, is distributed in such a way that it is naturally concentrated in the larger size fraction, in comparison to being less concentrated in the finest, most respirable size fraction (2017 Johnson abstract entitled, "Concentration methods improve detection limits for the analysis of talc for asbestos"). At first glance, this is counter-intuitive, as asbestos (single particles) are the smallest of mineral particles known. And, this is not to say that very small asbestos particles wouldn't also present, if a talc product were to contain asbestos. However, if asbestos truly is concentrated in the largest size fraction, and the largest particles are the easiest and least controversial to identify, then it is proposed that methods that focus on these larger particles (PLM and/or low magnification SEM) may be just as effective, if not more effective, than methods that focus on the smallest particles (TEM). One might ask, "What if only the smaller particles are present?" Research has shown, at least for the amphiboles, that it is impossible to have ONLY smaller asbestos particles, without also having the larger ones, when talc chunks and trace amounts of SRM amphibole-asbestos are co-milled to fine product specifications using aggressive wet grinding techniques (to simulate milling that happens in a plant scale grinding facility). This presentation will duplicate the study of talc spiked with SRM amphibole-asbestos (validated to 100 ppm) with a new study of talc spiked with SRM chrysotile to explore the possibility that these same principles also hold true for chrysotile, which traditionally has been suspected to require TEM for analysis.

The Ends Are In Sight

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Polarized light microscopy is able to rely on the population of fibers observed to determine whether or not the mineral is asbestiform. The analyst using an electron microscope generally does not have a population and may only see one or very few fibers in the area analyzed on an air sample. Laboratories include and exclude fibers/structures based on their description of an acceptable fiber and this can vary from laboratory to laboratory. Fibers or elongate mineral particles may be excluded from the asbestos count because of the shape of one end or the other, greatly affecting the results presented to the customer. This study will follow working standards and NIST amphibole samples from the stereoscope to the electron microscope.

Optical Analysis of the Fibrous/Acicular Zeolites: A Spindle Stage Approach

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Abstract (will wrap and grow): In recent years, analytical laboratories are seeing that in addition to receiving samples containing asbestos and amphibole minerals they are seeing an increase in zeolite samples, in particular the mineral species erionite. It is now evident that a reliable method of identification is needed which utilizes the equipment most readily available to these analysts such as the Transmission Electron Microscope (TEM) and Polarized Light Microscope (PLM). It is important to use a combination of identification techniques for these fibrous/acicular zeolites such as TEM, PLM and powder-XRD. Last Johnson Conference I focused on the TEM and this year identification by PLM will be explored.

According to literature, it is thought that the closely related zeolites erionite and offretite have refractive index (R.I.) values that do not overlap, specifically at 1.485 for epsilon (ε). Upon further analysis of R.I. values using the Spindle Stage and Abbe Refractometer on a suite of fibrous/elongate zeolites from various locations, the R.I. of erionite and offretite for both ε and omega (ω) are seen to significantly overlap, most likely due to overlapping chemical compositions. In addition to R.I., the Sign of Elongation for both erionite and offretite was thought to be a means to differentiate these two species (length slow for erionite and length fast for offretite). Again, upon further investigation, the Sign of Elongation can also vary between these species due again to similar chemical compositions and frequent intergrowths which makes determining Sign of Elongation anomalous.

Ultimately, a preliminary PLM investigation in addition to a more thorough analysis by TEM are the minimum amount of techniques required for the identification of erionite and other zeolite species. Until a precise chemical analysis can be performed on these fibrous/acicular zeolites using Electron Microprobe Analysis (EMPA), then optical identification solely by PLM will not be a reliable technique.

Electron Backscatter Diffraction for Phase Identification in Asbestos Analysis: Real World Case Studies

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Use of electron backscatter diffraction (EBSD) for phase discrimination has been thoroughly explored and shown to be a powerful technique when applied with care. Recent work has shown the applicability of EBSD for the identification of amphibole asbestos as well as mineral particulate in general. Transmission electron microscopy and selected area electron diffraction (TEM/SAED) can produce results which may lead to ambiguous phase identification unless time consuming analysis of SAED data is correctly undertaken. Background information on the principle of EBSD and a brief summary of work to demonstrate the applicability to asbestos analysis will be presented. Recent work to compare EBSD to SAED results will be presented. Examples presented will show it is possible to use SEM/EBSD to directly reexamine the same particles analyzed by TEM/SAED. Several case studies showing how EBSD was employed to resolve ambiguous phase identification by TEM/SAED will demonstrate the significance of the work done thus far to expand the technique into the asbestos analysis field. The addition of electron diffraction to SEM provides a means to greatly expand the capabilities and use of SEM in asbestos analysis. It also presents the possibility of automating asbestos analysis to allow for higher sensitivity and more detailed analysis of crystallographic data.

Comparison between PCM and TEM Analysis of Filters Loaded with LA-spiked Soil Standards using the FBAS Preparation Method

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Performance evaluation (PE) standards were prepared for Libby Amphibole Asbestos (LA) at concentrations of 0.0001%, 0.001%, 0.01%, and 0.5% (by mass). Filters were loaded using the Fluidized Bed Asbestos Segregator (FBAS) preparation method and the resulting filters were analyzed by both Phase Contrast Microscopy (PCM) and by Transmission Electron Microscopy (TEM). There was a linear relationship between the reported concentrations by TEM (expressed as structures per gram [s/g]) and the nominal mass percent. However, the PCM results showed no relationship between reported concentrations as s/g and the nominal mass percent. The PCM analysis was not able to distinguish between the PE standards when nominal levels were below 0.01%, but was able to distinguish the 0.5% standard from the 0.01% standard, which suggests the limit of resolution is somewhere between these two points. The results indicate that FBAS with PCM analysis may not provide better resolution than Polarized Light Microscopy (PLM) at distinguishing low levels of LA in soil.

Update on ASTM WK52495: Standard Test Method for Qualitative Determination of Fibers Consistent with Libby Amphibole Asbestos Fibers in Loose Fill Vermiculite by Transmission Electron Microscopy

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The goal of this work item has been and continues to be the development of a quick, simple, qualitative method. This method would detect the presence of amphibole fibers in loose fill vermiculite products so that the user or homeowner would use proper precaution if the vermiculite needed to be disturbed. It is well known that the loose fill vermiculite products that were mined from Zonolite Mountain near Libby Montana can contain substantial numbers of individual amphibole fibers. Disruption or handling of loose fill vermiculite may produce airborne fiber release if amphibole fibers are present.

The loose fill vermiculite insulation likely contains varying amounts of amphibole, frequently below 1%, but contains abundant fibers. The individual amphibole fibers associated with loose fill vermiculite products may not be visible by polarized light microscopy if the larger amphibole particles were not captured in the sampling and the Cincinnati method is expensive and time consuming. In this proposed method, if a loose fill vermiculite sample contains amphibole fibers, or elongate mineral particles, they will be suspended in the water, separated from the vermiculite sheets and be identified by electron microscopy. Examples of real world sample preparations will be presented and will illustrate the analyst's view in the electron microscope.

ASTM WK52495 was balloted in December 2016. Progress and concerns related to the ballot results will be reviewed. This method should be balloted in D22 Main and D22.07 and ready for discussion during the October 2017 ASTM meeting in New Orleans.

Insight into the Analysis on Dispersion Staining Curves

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It is well-known that the dispersion staining (DS) data obtained from the liquids using the polarized light microscopy (PLM) technique are reciprocal to the dispersion curve, the real refractive index (RI) values, of the sample examined under the same experimental conditions [McAndrew (1972); McCrone (1974); Laskowski (1979)], and evidently not linear even plotted in the Hartmann net [McCrone (1974)]. Commonly, although the parameters involved in each approach do not have any physical meaning nor are both models Kramers-Kronig consistent, the dispersion curves of mainly transparent materials with normal optical dispersion and no optical absorption in the visible light regime can be approximately described by either Hartmann's function or Cauchy's approximation; both are empirical and non-linear, whereas no explicit expression other than the linear format assumed for the corresponding DS curves can be found in the literature. The method of linear regression on the DS data presented in the Hartmann net, therefore, has been broadly utilized to reveal the RI values of the materials investigated at the Fraunhöfer spectral D line, $\lambda = 589$ nm, for decades. Yet, non-linear analytical approaches for DS curves have not been considered nor has the difference between the according RI values of samples at the Fraunhöfer spectral D line yielded by the conventional liner method and any non-linear analysis been explored and discussed. Consequently, the DS data from the NIST SRM 1866b for both α and γ via the Central Stop Dispersion Staining (CSDS) technique were illustrated in the original format, the RI ($n(\lambda)$) versus the wavelength (λ), and analyzed by both the traditional linear mean and non-linear regressions proposed, and the results are presented.

Examples of determining the detection limit for asbestos analysis using ASTM D6620

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As stated in ASTM D6620, the Detection Limit (DL) concept for asbestos measurements, which are based on an analyst using microscopy is simpler than the DL concept for measurement methods that depend, for example, on spectroscopy. For asbestos, the measurement is derived from a direct count of discrete structures using a microscope. For spectroscopy methods, the measurement is indirect requiring a calibration curve, and is subject to interferences and unspecified background signals that could be responsible for measurement values that are false positives. The two sources of false positives for asbestos counts are analyst errors such as counting non-fibers as fibers and contamination such as fibers on blank filters. Key to the DL in asbestos counts is the concept of an "analytical sensitivity". This sensitivity is defined as the structure concentration corresponding to a count of a single structure in a sample. For air samples the results are given in terms of fibers per cubic centimeters of air (f/cc) and the sensitivity depends on the volume of air collected, the size of the effective area of the filter used for collection, the size of the field of view or grid opening and the number of fields or grid openings counted. Increasing the volume of air sampled or increasing the number of fields of view or grid openings counted will make the analytical sensitivity of the measurement smaller (more sensitive). In D6620, the determination of the DL is made by consulting two tables. In the first table a fiber background mean 'decision value' is found based on the number of fibers counted during the analysis of blank filters. The second table provides a detection limit based on the decision value. The DL, stated in terms of f/cc units, is calculated by multiplying the detection limit from the second table by the analytical sensitivity. Example 1 for air samples from D6620 illustrates some of the parameters involved in using this Standard to determine the detection limit for an asbestos count analysis using phase contrast microscopy (PCM). In this hypothetical case, the analysis of 100 blank filters prepared as you would sample filters produced a result of 150 fibers detected. Based on Table 7 (Rule for Selecting x0 Based on Measurements from 100 Blank Filters), the decision value is 4. From Table 1 (Detection Limits for Different Background Means Measurement Unit Equals Number of Structures. Nominal Alpha = 0.005; Power = 0.95). the detection limit is 9.15. With a single fiber analytical sensitivity of 0.0005 f/cc, the detection limit is determined by the product of 9.15 and 0.0005 f/cc or 0.0046 f/cc. If less than 4 fibers are found, the measurement is to be reported as "below the detection limit of 0.0046 f/cc (<0.0046 f/cc)". Assume that 5 fibers are counted. The airborne concentration estimate is reported as 0.0025 f/cc. This value is an estimate of the mean concentration for the environment that is sampled. The statistical uncertainty associated with this estimate of the mean can be assessed by calculating the 95% upper confidence limit (95% UCL) for this result. From Table 10 (Upper Confidence Limits for the Poisson Distribution), the 95% UCL corresponding to a count of 5 is 10.51. The value of 10.51 times the analytical sensitivity of 0.0005 is 0.0053 f/cc. Other examples for asbestos analysis of air by transmission electron microscopy (TEM) and for the TEM analysis of surface dust samples (D5755 and D6480) follow a similar procedure.

Micro-Raman and Wavelength Dispersive Spectroscopy (WDS) analysis comparison of samples from former talc mines in the Gouverneur Mining District, New York

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This study compares compositional analyses by Micro-Raman spectroscopy and Wavelength Dispersive Spectroscopy (WDS) using an Electron Microprobe of tailing samples from two former talc mines in the Gouverneur Mining District, New York. Raman imaging maps the different phases while the microprobe precisely determines the weight percent oxides of the mineral phases. The samples were prepared as polished thin sections for our analyses. The two samples analyzed are from the Arnold Pit mine and the Talcville Mine.

The Arnold Pit sample is a talc schist with some tremolite and calcite. The talc occurs primarily as platy crystals and in some fine-grained masses. The tremolite and calcite within the sample occurs as unaltered, blocky crystals. Some of the tremolite and calcite crystals are fractured and filled in with a fine-grained talc. The Talcville Mine sample is a tremolite schist with some crystals of anthophyllite, talc, and phlogopite. The tremolite is long and acicular. Anthophyllite grains are fractured perpendicular to the long axis of the grain. Talc occurs within the sample as fine-grained masses along the edges of anthophyllite grains and within the fractures of the anthophyllite. Phlogopite occurs as plates in the sample.

There is consistency between Raman spectroscopy and microprobe analyses. The Raman maps provide more contrast among the differing phases than the backscattered electron (BSE) images. However, particular orientation of the sheet silicates and the amphiboles can cause misleading identification where mineral orientation in the BSE does not influence the image.

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WEDNESDAY'S POSTER ABSTRACTS

Elutriation Techniques

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As we try to hone our understanding of the health effects of various elongate mineral particles of environmental concern at variable concentrations it has become significantly important to succinctly characterize the fiber population under study. Further, in order to understand whether a given material should be considered as containing a hazard determined previously at issue we have striven to draw parameter-based lines about the subject we which to control. Elutriation is the process of separating particles based on their size, shape and density, using a stream of gas or liquid flowing in a direction usually opposite to the direction of sedimentation. This method is mainly used for particles smaller than 1 µm, and has therefore been the process sporadically called upon in asbestos science as a separation technique for refinement of a particle population into a more relevant sub-set of particulate to characterize and evaluate relevant to potential or relatablility to specific health impacts. Elutriation by air has been employed for development of relative evaluation of soils specifically, in many cases as a reactive product of needed response to soil contamination such as (not in small part directly from) Libby Montana vermiculite contamination. Elutriation by water has seen less application, but may well be of distinct interest in that more complete separation may well be possible, and some undesirable effects can be reduced if not eliminated. Practical examples include the previous works by others including the paleolimnology study of upstate New York talc by Webber and its echo in the Sumas Mt. study. Recent improvements and variations using similar water elutriation has proven promising in the research of the author recently, where new data point to a better understanding of the efficacy of water elutriation as a reflection on theoretic values bases on traditional setting velocity predictions.

Sink or swim: analysis of heavy liquid separation methods for asbestos in talc and vermiculite, and tips for obtaining the best results

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Methods for separating asbestos from either talc or vermiculite products using heavy liquids are not new. Modern techniques have moved away from the more toxic heavy organic liquids to compounds such as lithium polytungstate and sodium polytungstate. However, analysts have reported mixed results in obtaining good separations, especially with talc products. This presentation will draw on the author's long-standing experience with separating mineral fractions using heavy liquids. We will explore how temperature, ultrasonication, centrifugation, and the use of sink/float standards affect the quality of separations. The industrial talc products Mouldene, Nytal99, and Asbestine will be used as examples and x-ray diffraction patterns as well as polarizing light microscopy will reveal the effectiveness of each method for separating the regulated asbestos minerals from other components.

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Abstracts for Thursday Morning, August 3, 2017

SESSION 5: METHODS AROUND THE WORLD & MISCELLANEOUS

Measuring asbestos in heavy dusting conditions

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Abstract to be updated in January with interlaboratory results. Basically, a large interlab study with samples collected at different time intervals under very dusty conditions. Comparisons of direct and indirect methods. Measurements of asbestos exposure in very dusty conditions lead to a short sampling time to avoid overloading of filters. The analytical sensitivity in these situations is poor and due to the short sampling time the exposure datas are scattering and hence are not very reliable. In a study improvements have been investigated. Due to the participation of 8 laboratories each evaluating a piece of the same filter and parallel sampling of at least two filters at the same time the analytical sensitivity of the short time measurements was improved considerably in each time segment. During one exposure situation three short time measurements have been evaluated and compared with results from filters covering the whole exposure period and when overloaded an indirect method was used. This procedure has led to improved exposure datas and the possibility to compare direct and indirect results. The measurement technique used was the gold coated membrane filter method with SEM evaluation (DGUV I 213-546 the German method for workplace measurements of fibrous dust similar to VDI 3492)

ASBestos-IN-Soil (ASBINS) - Australian experience

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ASBestos-IN-Soil (ASBINS) has been a significant legacy issues for Australia for many years. However, since 2000, a Risk- (rather than Hazard-) based approach has gathered support, resulting in 2009 in State regulatory Agency guidance for the assessment and management of ASBestos-IN-Soil using risk-based approaches. This subsequently resulted in 2013, in an Australia-wide regulatory guidance that has been adopted across the country to assess and manage ASBIN issues. This paper provides case studies from the past seven years on the performance of the risk-based approach to ASBINS, demonstrating savings of many millions of dollars, and the successful unlocking of stalled brownfield developments.

Drywall Joint Compound by Visual Estimation, Point Counting, and TEM

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Drywall joint compounds can be difficult samples to analyze by EPA PLM methods and it is not uncommon to find low concentrations of asbestos near the 1% level. Results for these samples are typically reported as less than 1%, trace, or 2%. The EPA asbestos NESHAP regulations (40 CFR Part 61.141) require for samples containing less than 10% asbestos, the client either; assumes ACM by visual estimation or to employ a 400 point counting procedure to determine asbestos percentage. In net effect, to determine if truly <1%, point counting procedures must be used. Using this method it is not uncommon for a joint compound sample that was determined to be greater than 1% result by visual estimation to become less than 1% when point counting procedures are used. Factors that contribute to this include, among others: manufacturing of the joint compound, analyst overestimation, analyst experience, matrix interference, and asbestos fiber size. If the sample is then prepared using gravimetric techniques and analyzed by TEM bulk methods, such as the NYSDOH ELAP 198.4, greater than 1% asbestos is often found. This can leave the end user with the dilemma of having a less than 1% PLM point count result, which is in compliance with NESHAP, and a greater than 1% TEM result. TEM is considered a 'best practice' in this case, its use is not required for NESHAP compliance. This study will compare the analysis of numerous joint compound samples by all three methods and show the frequency of result changes within those methods.

Framework for Assessment and Phytoremediation of Asbestos-Contaminated Sites

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Approximately 1,000 sites in the U.S. and many more throughout the world are contaminated with naturally occurring asbestos or asbestos-containing materials, which pose serious health risks to millions of people. Because the recommended remediation method (soil capping) is too expensive, a majority of the sites, including brownfield sites, are typically left untreated. We examine the feasibility of phytoremediation as an alternative strategy to limit the exposure of asbestos. We collected soils from two locations at each of two sites—one with naturally occurring asbestos, and another, the BoRit Superfund site, where chrysotile was used in manufacturing and asbestos containing materials were discarded over decades. We performed soil analyses for asbestos content and an ecotoxicology test using three grass species. Finally, we determined asbestos concentrations in water from two different test wells at BoRit, MW4 and MW6.

The ASTM D7521-13 method provided better insight into asbestos concentration and distribution among soil size fractions than the standard CARB 435 method. Concentrations in different soil size fractions varied by orders of magnitude. However, different asbestos concentrations had little effect on germination and root growth. Presence of co-contaminants such as heavy metals and lack of nutrients affected plant growth to different extents, suggesting these as limiting factors instead of asbestos.

Measured by the 100.2 Method, a standard method used by EPA to quantify asbestos fibers >10 µm, asbestos concentrations were 15 and 4.10 million fibers per litter (MFL) for BoRit test wells MW4 and MW6 respectively. We found far higher asbestos concentrations when measuring fibers >0.5 µm in both wells, with 79 and 9.2 MFL. Concentrations were higher than the EPA threshold of 7 MFL. These data provide more evidence that asbestos fibers can contaminate ground water and suggest the need for continued monitoring.

Site Assessment and Characterization of Talc at Fontana, Gianna and Paola Horizons, Italy

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In 2015, a site assessment of an active Italian talc mine, sorting and milling facility was performed. The assessment also included a visit to the historically mined horizons accessed by the underground museum. Objectives for the site assessment included observing the mining, sorting and milling procedures and to characterize collected specimens for the presence of asbestos and other minerals. A generalized overview of the geology that formed the talc will be discussed as well as testing protocols used to characterize collected samples (XRD, PLM and TEM). Results and conclusions will be discussed highlighting the minerals identified.

ISO Standard Methods for Determination of Asbestos

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Since the formation of the ISO/TC 146/SC 3/WG1 working group in the mid 1970's, 7 International Standards for determination of asbestos have been published. These are:

ISO 10312:1995: Ambient air — Determination of asbestos fibres — Direct-transfer transmission electron microscopy method;
ISO 13794:1999: Ambient air — Determination of asbestos fibres — Indirect-transfer transmission electron microscopy method;
ISO 14966:2002/Cor 1:2007: Ambient air — Measurement of inorganic fibrous particles — Scanning electron microscopy method;
ISO 16000-7:2007: Indoor air — Part 7: Sampling strategy for determination of airborne asbestos fibre concentrations;
ISO 22262-1:2012: Air quality — Bulk materials — Part 1: Sampling and qualitative determination of asbestos in commercial bulk materials;
ISO 22262-2:2014: Air quality — Bulk materials — Part 2: Quantitative determination of asbestos by gravimetric and microscopical methods;
ISO 22262-3:2016: Air quality — Bulk materials — Part 3: Quantitative determination of asbestos by X-ray diffraction method.

Currently, ISO 10312 and ISO 13794 are under revision, and it is anticipated that revised versions of these standards will be voted on during 2017. Revision of ISO 13794 has been delayed because a number of laboratories have experienced problems when attempting to ash currently available MCE filters. The problems are related to the presence of silica remaining after ashing, sometimes resulting in a residual fragment that cannot be completely ashed. This problem is under investigation. Unfortunately, air sampling for asbestos is a very small proportion of the market for MCE filters, and consequently the filter manufacturers have little interest in determining the cause of this problem.

ISO 22262 currently consists of three parts. ISO 22262-1 recognizes that quantification of asbestos by visual estimation is adequate for many analytical requirements, but unreliable for quantification at concentrations estimated to be below approximately 5%. ISO 22262-2 and ISO 22262-3 are intended to provide more reliable methods for quantification of asbestos at concentrations below approximately 5%. The use of ISO 22262-1 is a prerequisite for the use of either ISO 22262-2 or ISO 22262-3 to quantify any asbestos that may be present.

The scope of the working group has recently been expanded to include the determination of asbestos in soil.

Evaluation of Friction Materials for Asbestos and Investigation of Fiber Release

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Over 50 countries have issued complete bans on asbestos[1]; however, the United States is not one of them. The misconception that asbestos has been banned in the US is unfortunate and in some cases may lead to oversight in buildings or products constructed or manufactured after the 1980s. In the US, there is a limited ban on certain materials - NESHAP covers spray-applied surfacing and thermal system insulation (TSI); the Toxic Substances Control Act covers certain types of paper, felts, and "new uses" of asbestos; and the Consumer Product Safety Division bans consumer uses of textured paint and wall patching compounds[2]. Because there is no federal ban on asbestos-containing products, there is no system in place to track or test products currently on the market. On 6 September 2016, the Motor & Equipment Manufacturers Association (MEMA) submitted a letter to the US EPA requesting to designate asbestos as a high-priority substance for future risk evaluation[3]. The letter suggests that although "U.S. brake manufacturers do not use any asbestos at all when manufacturing brake friction materials," imported sources make no such claim. As a matter of fact, the Department of Commerce submitted a report to Congress in 2015 indicating that 2013 imports of friction materials included approximately $2.2 million in asbestos containing brake friction materials[3]. Until a ban can be implemented, it falls to knowledgeable resellers or end users of imported goods to inquire or test for the presence of asbestos in those brake products. As for the brake mechanics, most are under the impression that asbestos is no longer a concern and may be exposed to dust containing asbestos when they don't expect it. Testing of vintage friction components (often containing 50% or more asbestos) can be accomplished using standard polarized light microscopy techniques. Investigation of trace levels (less than 1%) of asbestos often requires matrix reduction followed by examination via transmission electron microcopy. The author will discuss a series of bulk PLM and TEM examinations on vintage friction products (pre-2000s) and present the results of multiple studies evaluating the release of asbestos fibers. Documented asbestos fiber release will be presented for various activities like the handling, sanding, and machining of new friction linings as well as the removal and cleanup of after-service friction linings.

Notes: References 1. International Ban Asbestos Secretariat, http://ibasecretariat.org/alpha_ban_list.php, accessed on 24 October 2016.2. EPA Asbestos Materials Bans: Clarification, May 18, 1999, https://rms.unlv.edu/occupational/asbestos/EPA Asbestos Ban.pdf, accessed on 24 October 2016. 3. A. Wilson, Senior Vice President, Government Affairs for the Motor & Equipment Manufacturers Association, "RE: Request to Designate Asbestos as a High-Priority Substance Under TSCA § 6 Due to Use in Brake Friction Materials," September 6, 2016.

Asbestos-Containing Materials Associated with Steam Locomotives

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The nineteenth century saw the arrival of railroads to the United States. Steam-powered locomotives were their primary means of propulsion during the Golden Age of the railroads until the 1950s. Almost all steam locomotives used the horizontal fire tube design with a firebox and a boiler to generate steam. The boilers and fireboxes were usually insulated with asbestos-containing insulation, as were many pipes, valves, and other locomotive components. Seals in the form of gaskets and packing were also used. Asbestos-containing materials were utilized to a lesser extent on other rail cars. Personnel working on the construction and maintenance of the steam locomotives have developed all the recognized asbestos-related diseases. Dr. Chris Wagner in his seminal article connecting malignant mesothelioma to asbestos exposure in 1960, specifically recognized exposure to asbestos from steam locomotives as two of his first cases. Dr. Thomas Mancuso documented many more during the 1970s - 1990s among the ranks of the machinists working the back shops of the railroads where the locomotives were stripped of insulation and rebuilt. Most steam era locomotives were removed from service during the 1950s, although some continued in service into the 1960s. Operating steam locomotives today are used only for scenic and heritage tours. Most steam locomotives were scrapped or sold to railroads outside the U.S. However, many remain on display around the country as exhibits in towns and museums. Most of these still contain much of the asbestos-containing insulation, and other asbestos-containing materials. These materials are removed or disturbed during maintenance and restoration activities. Bulk samples collected from steam era locomotives during the past 20 years demonstrates large quantities of asbestos-containing materials remain associated with this old equipment. Amosite and chrysotile were the most common forms of asbestos found, although crocidolite has also been found. The locations, concentrations, and condition of the asbestos-containing materials found are described. Organizations undertaking to restore steam era locomotives should apply recognized asbestos control measures when disturbing or removing these materials.

ITALIAN ASBESTOS SUPERFUND: THE IMPORTANCE OF ON SITE SURVEYS, SAMPLING AND ANALYSIS

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Italy was one of the first Countries internationally to ban asbestos, in 1992. But in past time, until the 1990s, Italy was among the world's leading producers of raw asbestos fibres and Asbestos Containing Materials (ACM). In fact having former asbestos mine (Balangero and Emarese) and 8 ACM factories, it is one of the most contaminated Countries in Europe. So, at the moment, in Italy, asbestos is no more used and traded but remain many contaminated sites requiring remediation and significant quantities of asbestos-containing waste need to be disposed of.The asbestos mines and factories have been all classified as Italian Asbestos Superfund, to remediate with Governmental financial support managed by Environmental Ministry, with the Scientific Support of National Research Institutes, included INAIL, which represent the main partner to prevent new asbestos exposure and to establish remediation procedures and specific Guide Lines.In this paper we report the INAIL experience concerning remediation activities in the Balangero and Emarese asbestos mine and in two important former asbestos factories, Broni Fibronit and Ferrandina Materit, highlighting the importance of surveys on site by public and independent inspectors and their monitoring and analysis. The authors want to remarque that analytical data need to be inserted in an extended knowledgment of an asbestos contaminated site, to be representative of the real environmental and health risk.

Asbestos-cement's underground networks: technical, operational and safety issues

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Italy is one of the countries in the world with a significant and sustained increase in asbestos related diseases. This as a result of huge manufacturing of asbestos and consumer goods made in our country, with an estimated production/import, in the period 1945-1992, of more than 5 million tons of asbestos fibers. Since 1992 production, import, trade and processing of asbestos were banned and the use of asbestos in new buildings has ceased. However, large amounts of asbestos-containing materials (ACMs) are present both in residential buildings and in industrial sites, with several areas of intervention and research still open. Among the more than 3,000 types of products containing asbestos, the asbestos cement pipes have been widely distributed throughout the Italian territory. This is because in the past they were used, in addition to the construction of industrial installations, also for the realization of the services networks (gas and water supply, sewage, etc.). Currently, there is no comprehensive census of underground pipes still in place, but only fragmentary data are available, related to a limited number of municipalities. Theoretically, it was estimated that over 100,000 km of asbestos-cement pipes have been installed in Italy, of which only a small part has been removed. In case of maintenance work, repairs, replacement or removal of such ACMs, the excavation of the soil leads to outcrop of the pipes with exposure to ambient air. In such situations, it can emerge a risk for the workers involved and for neighboring living environments. Given the legislative gap on the matter and the extreme variability of situations that may be encountered on field, in the present paper we point out the main problems and preventive and protective measures deemed more suitable in the case of operations on asbestos cement's networks or in the case of emergency or remediation interventions without information on the asbestos presence.

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Abstracts for Thursday Afternoon, August 3, 2017

SESSION 6: LEGAL ASPECTS

The Case of Asbestos-Containing Cigarettes

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During the period of approximately March 1952 through May 1956, the Micronite® filter in Kent® cigarettes used crocidolite asbestos as part of the filtering agent. There was no barrier or secondary filter between the end of this filter and the customer's mouth. It has been estimated that approximately 585 million packs (more than 11 billion cigarettes) were sold in the United States using this design with advertising that emphasized the "health protection" supposedly provided by the filter. Several packages of the 1952-1956 vintage Kent® cigarettes were obtained in their original sealed packaging and analyzed by Polarized Light Microscopy (PLM), Scanning Electron Microscopy (SEM), and Fourier Transform Infrared microspectrophotometry (micro-FTIR). The outer paper wrapper on the filter consisted of a white paper layer and a tan coating layer. The white paper was part of the continuous white paper that covered the entire cigarette. The inside of the filter consisted of rolled crepe paper with loose fibrous material. Some carbonate particles were also present. Both the white paper and the crepe paper were consistent with chemically processed wood paper fiber. The loose fibrous material consisted of crocidolite, cotton, and cellulose acetate fibers. The composition of the filter in terms of approximate percent by weight of total filter were: outer paper (white paper and tan coating), 16%; crepe paper including carbonate, 62%; crocidolite asbestos, 6%; synthetic fibers (cellulose acetate), 4%; and cotton fibers,12%. A corporate document described the Micronite® filter as containing cotton, crepe paper, cellulose acetate fibers, and approximately 7% to 25% crocidolite asbestos.(1) The samples were examined for evidence of deterioration. No signs of mold, insect attack, or other deterioration were found. The crepe paper was found to be very flexible and had not become brittle with age. Arrangements were made to test for particle release from regular and king-size Micronite® filter Kent® cigarettes using a standard smoking machine following generally accepted International Organization for Standardization (ISO) and Canadian smoke testing protocols.(2,3) A non-asbestos Kent® cigarette (later vintage) was smoked as a control. The smoke was collected on glass fiber Cambridge® filters. The filters were prepared for Transmission Electron Microscopy (TEM) using an acid/base digestion of the glass filter fiber that does not affect amphibole crocidolite fibers.(4) The samples were analyzed using American Society for Testing and Materials (ASTM) Standard Method D6281 for asbestos.(5) Crocidolite asbestos fibers were found to be released in the smoke of both regular and king-size Kent® Micronite® filter cigarettes. Reference(s): (1.) Defendant Lorillard Tobacco Company's Responses to Plaintiffs' Standard Interrogatories (First Set) In the case of Joe Haberthur v. Advocate Mines, LTD, et al., in Superior Court of the State of California, County of Los Angeles, Case No. BC 433318. (2.) International Organization for Standardization Routine analytical cigarette-smoking machine—definitions and standard conditions. ISO Standard 3308, 4th ed. ISO 2000. (3.) Determination of "Tar," Nicotine and Carbon Monoxide in Mainstream Tobacco Smoke, Health Canada Method T-115, 1999. (4.) Millette J.R., Harmon A., Few P., Turner Jr. W.L., Boltin W.R. Analysis of amphibole asbestos in chrysotile-containing ores and a manufactured asbestos product. Microscope, 57(1):19-22, 2009. (5.) American Society for Testing and Materials, ASTM D6281-09, Standard Test Method for Airborne Asbestos Concentration in Ambient and Indoor Atmospheres as Determined by Transmission Electron Microscopy Direct Transfer, 2009.

Differentiation of Amphiboles and Inadequacy of Current Methods for Asbestos Analysis

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Current methods for asbestos analysis are written for relatively high content or significant numbers of countable fibers or structures typical of chrysotile or chrysotile-derived asbestos materials. Therefore, extent methods (EPA, NIOSH, OSHA, AHERA, Yamate) are inadequate for relatively low-level asbestos content determination in vermiculite, talc, or other materials, especially when amphiboles are most likely associated including actinolite, tremolite, anthophyllite as they co-mineralize with chrysotile (Addison-Davies). It is well recognized that the percent content of asbestos in a bulk material is not relevant to health hazard potential. Regardless, comparison of calibrated visual estimates in PLM grain mount or gravimetrically-reduced residues to calculated weight percents using TEM measured length and width applied to mineral specific gravity rarely correlates and can be confusing and misleading. Further, typical counting protocols for TEM conducted at 10-25,000 X of 4-20 grid openings works well when quantifying well-dispersed chrysotile, but falls short once out of this limited application. Further, Properly-trained TEM asbestos analysts that the determination of amphiboles in a sample may invoke utilizing the complicated technique of confirmation of the mineral identification by dual double-tilt or tilt-rotate zone axis electron diffraction verification of the crystalline structure, as outlined in the draft method written by George Yamate "Level III analysis". As many minerals may exhibit "non-tilted" 5.3Å repeats in Selected Area Electron Diffraction (SAED) due to the silica tetrahedral arrangement common to many silicates, parallel lineations of streaks and chain faults near perpendicular to the fiber axis at this periodicity are, subjectively, characteristic to amphiboles. There is a lack of accepted crystalline data to which measurements can be compared and there is no written consensus as to the acceptability of that comparison, and the final determination of asbestos presence can or cannot be determined based on this analysis.

Asbestos Exposure Litigation Case Types: What is hitting the Courtrooms Today

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Asbestos litigation has been slowly but surely evolving in a reactive recognition of the denouement of traditional asbestos exposure from mining, processing, and asbestos-containing building material exposures to the slow crescendo of secondary routes of asbestos exposure realized in the human health response. What is secondary exposure to asbestos? Well, that ranges from the wide world of contamination of vermiculite, talc, and other mineral resources that may well be associated in the earth with lithologies and geologic processes conducive to asbestos co-mineralization to the ever-expanding conceptual understanding of the fleeting yet pervasive reality of elongate mineral particles of potential human health concern from heretofore unrecognized routes from take home exposures to natural occurrences disturbed in our unsuspecting neighborhoods. As commerce marches on to a once strong beat, only memories of confident industrial progress without fear of unrecognized hazard potential still march on unimpeded. Now more than ever, we need to provide clear messages for progress, and speed to the scientific evaluation on possible hazard in our efforts to recognize and protect the public from our charge in the foggy asbestos arena. Examples of the myriad of asbestos-related recent cases include common and odd vectors including soils, gravel, talc, garden products, skiing, pottery, or radio repair.

Taz and Sons: Bad removal of asbestos coated pipeline

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In 2011 a pipeline in NE Texas was being excavated. A state inspector conducted and inspection and informed the workers that the pipeline was coated with asbestos. The owner of the company received training on the proper removal and handling of ACM. Later, when another site was inspected, the state saw that again, the pipe continued being removed without being wetted or contained. Debris was left on the ground as the pipeline was dug up and dragged to the road. The asbestos was not disposed of at any approved disposal facility. This presentation will discuss the excavation, sampling of debris and legal issues.

Liberty Fibers: Asbestos NESHAPs investigation, Criminal Prosecution and Superfund Victim Restitution Order

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In 2006, Mark Sawyer and four others formed A&E Salvage to purchase the salvage rights to Liberty Fibers, a former rayon manufacturing operation located in eastern Tennessee. The 300-acre industrial site included a number of buildings, a waste water treatment plant, extensive above-ground piping, and large amounts of regulated asbestos-containing materials. Despite knowledge of the presence of asbestos in the form of pipe wrap, insulation, and floor tiles, A&E Salvage conducted salvage operations and building demolitions at the site from October 2006 to July 2008 without complying with the Clean Air Act's National Emission Standards for Hazardous Air Pollutants. As a result of the illegal salvage and demolition activities, asbestos was spread over the site. The United States Environmental Protection Agency had to step in to address the contamination under the authority of the Comprehensive Environmental Response, compensation and Liability Act (Superfund). The total cost of the cleanup was more than $16 million.

Following a criminal investigation by EPA, Sawyer admitted that he had conspired with others to violate the Clean Air Act by failing to remove asbestos from the buildings prior to conducting salvage and demolition work, failing to properly handle the asbestos at the site, and failing to follow other work practice standards. Sawyer received a 60-month prison sentence, and pursuant to the Mandatory Victims Restitution Act, Sawyer and his co-defendants were ordered by the United States District Court to pay over $10 million to the victim of their crime – EPA. Sawyer appealed his sentence and the restitution order to the United States Court of Appeals for the 6th Circuit arguing, among other things, that EPA was not a crime victim entitled to restitution because it did not have an ownership interest in the site. The 6th Circuit did not agree and affirmed Sawyer's sentence and the restitution order.

The purpose of this presentation is to discuss the criminal investigation and prosecution at the Liberty Fibers site, including the sampling and analysis, and the issues related to EPA's status as a crime victim eligible for restitution as part of a criminal sentence.

Evaluation of the Proposed Correction Factor for Comparing the Ratio of Indirect and Directly Prepared TEM Samples Containing Amphiboles

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The use of indirect preparation for asbestos analysis by TEM has been used by the U.S. Environmental Protection Agency (EPA) as a method of collecting exposure data in the vicinity of Libby Montana to support risk assessments. We have reviewed several studies conducted by EPA in the vicinity of Libby in which side-by-side samples were collected and analyzed using direct preparation (the generally accepted method) and indirect preparation (EPA's proposed alternative method). These studies represent the largest known collection of replicate field samples prepared by direct and indirect methods for asbestos analysis. Contrary to Goldade and O'Brien's reported 2- to 4- factor increase between indirect and direct analysis for total Libby Amphibole (LA) and LA in the length ≥ 5 μm fraction, we find the differences between indirect and direct preparation of samples at Libby to be significant and highly variable depending on location and activity. The EPA studies at Libby show an average increase of indirect to direct ranging from approximately 1 to about 80. Goldade and O'Brien's conclusion that "the differences between direct and indirect preparation techniques are not a significant factor" is not reliable. The traditional view that indirect preparation is not an acceptable alternative to direct preparation for evaluation of human health risk related to airborne amphibole asbestos exposure is correct. These results challenge the validity of EPA's recent risk assessment for Libby and suggest EPA's exposure data do not support the finding of a non-cancer endpoint of significance resulting from low level exposure to mixed amphibole dust.

Serpentine and amphibole group mineral characterization in talc ores and talc based products accurate, repeatable, and defensible SAED evaluations.

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Allegations of asbestos contaminating historic and current talcum powder products increase the need for scientifically accurate testing as well as scientifically defensible data. This continues to be paramount in the evaluations of known and prospective talc sources. The majority of asbestos laboratories employ air based TEM methodologies like AHERA. TEM results are only valid when based on sound scientific principles, over the past two decades asbestos analysis has become a commodity-based analysis. Although advantageous for cost reasons to the asbestos abatement and related monitoring industries, when materials such as talc are examined false positives do occur unless the fundamentals of mineralogy and crystallography are applied in the interpretation of data. Fundamental to the occurrences of these type I errors are the interpretation of electron diffraction patterns. When simplistic procedures are followed the result is scientifically flawed data for talc-based products. For scientifically correct and defensible data, those with a correct understanding in crystallography must employ quantitative zone axis determination. Examples of real world type I errors made by multiple asbestos labs testing raw talc will illustrate the need for zone axis indexing and the need for additional training in relation to electron diffraction interpretation.

Detect or not to detect: a discussion on when is zero actually zero?	
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When polarized light microcopy (PLM) is used to perform a quantitative point count analysis of material, there will be ambiguity on how to handle the scenario where an analyst observes asbestos in the field of view but not on a graticule point. Hundreds of points can be counted to achieve a very low detection (or quantification) limit while asbestos fibers that may be present are never counted and therefore not quantified. How should this scenario be reported to be both informative for a client or decision maker, yet scientifically accurate? Guidance in EPA 600/R93/116 is that the analyst "...should record the presence of any asbestos observed..." This could mean that the quantification result is 0% in spite of asbestos being observed within the sample. The case could also be that no asbestos is counted on a point and no asbestos was observed anywhere within a field of view. . These two possibilities lead to 0% results having different meanings. The observation of asbestos using microscopy is a binary phenomenon (i.e. it is either seen or not seen) and the concept of detection limit becomes a challenge to apply. From a labelling or abatement point of view, this situation has little impact since the threshold values are very high relative to a reasonably low, easily achievable detection limit. However, from a litigation or risk mitigation point of view, these are potentially significant differences. Furthermore, ambiguity in how to report observed asbestos could lead to confusion when making interlaboratory comparisons. A deeper discussion of detection limits and quantitation of very small amounts of asbestos during point counting should be beneficial for those looking to bring clarity to this subject, both for themselves and for the clientele whom they serve.

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THURSDAY'S POSTER ABSTRACT

Asbestos in Consumer Products

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Finds of asbestos in consumer products such as crayons, fingerprinting powders, joint compounds, window spackles, and art products have gone in fits and starts periodically through the last 40+ years of analyzing materials. Unique determinations of asbestos presence have sporadically forged new ground, often catalyzing other studies in a causal chain of testing of consumer products through history. This presentation will illustrate a timeline of such events, to include very recent testing in which new findings mimic the old, both in the vectors by which the asbestos was found, and, ironically, the uniqueness and novelty of the discoveries- including new findings of asbestos in (wouldn't you just know it): crayons, fingerprint powders, and cosmetic talc, in the course of the research of the author. Unique insight into the process of taking new research findings to the public through the media will be illustrated, comparing the motives and philosophical differences between commercial interests, the press, and the laboratory. At the end of the day, the desire of the scientist as consultant to the public must be to assure reasonable public awareness, protect public health, and to present timely new findings from cutting-edge research without creating irrational fear.

Johnson Conference 2017

Abstracts for Friday, August 4, 2017

SESSION 7: RISK EVALUATION

The good, the bad, and the ugly: Selecting analytical methods for different purposes

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Awareness of asbestos's potential for harm has been known for more than a century. While the long and thin asbestos fiber hypothesis of Stanton et al. more than 30 years ago remains viable, clinical, epidemiologic, and toxicological studies since then have implicated a more diverse population of mineral fibers that can cause disease when inhaled. The relationship of these factors to available analytical methods will be discussed.

Elongate Mineral Particles: What Should be Measured?

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Size distributions of elongate mineral particles (EMP's) or fibers are generally approximately logarithmic normal, which means that there are many more small particles or fibers than large ones. More than 40 years ago, when transmission electron microscope (TEM) methods for determination of asbestos in air and water were being developed, it was found that detection of fibers shorter than 0.5 µm was unreliable. For this reason, 0.5 µm was established in both ISO and ASTM TEM methods as the shortest fiber to be recorded in fiber counts. When counts of 100 - 200 fibers include all fibers longer than 0.5 µm, it is often found that the longest fibers in the size distribution, which are considered to be the most biologically significant, are either not detected or their numbers are statistically limited. When a reliable TEM measurement of the entire size distribution is required, the optimum approach is to perform two separate scans, one for fibers with lengths of 0.5 µm up to 5 µm and a second examination that records only fibers longer than 5 µm. The results of the two fiber determinations can then be mathematically combined.

The question has arisen as to what size range of EMP's should be measured from the perspective of potential carcinogenic response. Although a significant body of experimental work exists that implicates only long and thin fibers in the development of tumors in animals, concerns have been expressed that EMP's shorter than 5 µm could play a role in causation, because of the larger numbers of these in any population of EMP's and also their ability to migrate in tissue. Accordingly, some have advocated that in future studies, fiber counts should include all fibers down to 0.5 µm in length. Others consider expenditure of effort on measurement of fibers shorter than 5 µm to be a waste of research funds and has the potential to compromise reliable determination of longer fibers.

Size distributions of the materials used in past animal studies were often not fully characterized, and frequently dosimetry was only expressed in terms of weight. However, materials remaining from some of the previous studies are still available, and measurement of accurate size distributions could assist in resolving the issue of fiber size and carcinogenic response. Some occupational and environmental situations have also been studied extensively, and further examination of the materials involved in those situations could also provide information on the fiber size ranges that relate to the observed health effects.

A new PCM equivalent TEM method for Risk Assessments

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The assessment of an asbestos-contaminated site for risk evalutations is done currently using transmission electron microscopy (TEM) methods, such as either the NIOSH 7400 or ISO 10312 methods. Both of these methods provide good information to risk assessors. Another method, ASTM WK 51609, is being developed using different approaches to the PCM equivalent (PCMe) methodology by TEM. Several changes in analytical methodology will be recommended based on comparisons of fiber counts from either of the other PCMe methods.

Comparison of PCM and TEM-PCME Concentrations for Nearly 10,000 Air Samples Collected from the Libby Asbestos Superfund Site

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PCM is typically used as the primary analysis method for worker air samples collected as part of OSHA health and safety monitoring. A key limitation of PCM analysis is that structure discrimination is based only on size and shape. Because of this, it is not possible to distinguish between asbestos and non-asbestos structures, which means reported PCM air concentrations may be biased high relative to the actual asbestos air concentration. For this reason, analysis by TEM has been the preferred method when evaluating inhalation exposures in human health risk assessments. Estimated air concentrations reported by TEM analysis are expressed in terms of PCM-equivalent (PCME) structures to allow for comparisons to asbestos toxicity values, which are usually based on PCM. At the Libby Asbestos Superfund Site in Libby, Montana, there are more than 9,500 air samples that have been analyzed by both PCM and TEM. These analytical results are used to determine the difference between PCM and TEM-PCME air concentrations, which provides information on the degree of potential bias in the PCM results. In addition, these data are used to evaluate the differences in reported air concentrations between the two methods for several sampling and analysis variables, such as the surrounding environment (indoor vs. outdoor), sample type (personal vs. stationary monitor), contamination source (mine site vs. residential), and TEM counting rules (AHERA vs. ISO).

A Bayesian approach for estimating exposure point concentrations with low count asbestos air data

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Inhalation exposure to asbestos is associated with lung cancer and mesothelioma. Per EPA's Framework for Investigating Asbestos-Contaminated Superfund Sites, asbestos cancer risk is calculated as the product of an exposure point concentration (EPC), a time weighting factor, and a cancer inhalation unit risk. Although EPA generally recommends the use of a 95% upper confidence limit on the mean (95UCL) for an EPC in Superfund risk assessment, their Framework instead recommends using the mean, because of the perceived challenges of estimating a 95UCL with the low-count asbestos air data that are common in outdoor settings. In this work, a new Bayesian model is presented that 1) is robust to air samples with low or zero fiber counts, and 2) allows for calculation of a distribution of EPCs to support estimation of a 95UCL. The model is particularly relevant when asbestos air data represent a large or complex assessment area because the distribution of EPCs can represent potential spatial variability in air concentrations. The model is demonstrated using simulated low-count data from air sampling events at multiple locations related to a common source of asbestos fibers. Asbestos air data from personal air samplers worn during activity-based sampling, and from ambient air monitors, are applied. EPCs and risk assessment results based on Bayesian model EPCs are compared to those using the EPA Framework mean and the advantages of the Bayesian model are described.

Mesothelioma in Jefferson Parish, Louisiana: A follow-up of America's largest current asbestos epidemic.

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Highest concentrations of mesothelioma cases have been noted by the National Cancer Institute to occur in counties having either asbestos-using industrial plants, shipyards, or both. Between 2003 and 2008 we identified cases in Jefferson Parish, Louisiana available from litigation files and presented evidence including work, residential and occupational histories for 22 cases (ten female). Lung-retained fibre analysis was presented for nine cases, and there was significant evidence of environmental exposure to Johns-Manville crocidolite-containing scrap used on 1500 properties later remediated by EPA (Case BW and Abraham JL. (2009). Heterogeneity of exposure and attribution of mesothelioma: Trends and Strategies in Two American Counties. J. Phys.: Conf. Ser. 151 012008 1-15). In September of 2014 NIOSH updated data for US counties, and found that from over the most recent ten years the age-adjusted rate remained 32 per million adult population, age adjusted. Jefferson Parish remains 12th in the nation for mesothelioma death rate, and is the highest county of the top fifty in terms of absolute deaths (118 over ten years). This is one order of magnitude greater than Lincoln County, Montana, where Libby is located. In addition, the female proportion remains the highest in the nation at 36%. Over the seven years since our last assessment, we have reviewed some 50 additional new cases. Most exposure information is from deposition testimony; well over half of new cases had JM scrap on or near their properties during childhood years. Additional exposures were derived from environmental sources (principally proximity to the plant), from domestic exposures, and on occasion from occupational exposures. I report on these new cases with summaries of exposure data and an approach to causation analysis which emphasizes time from first exposure and exposure to commercial amphiboles. Unfortunately, exposure continues due to poor site remediation. This is the worst mesothelioma epidemic in the United States, and is analogous to similar epidemics around crocidolite cement pipe plants in Japan and Italy. Nevertheless, it continues to received little attention from government or from academia. Possible reasons for this are discussed as well.

Chrysotile in California Reservoir Water: Is it an H&S impact?

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Like many reservoirs that receive water from metamorphic rock belts, the Calaveras reservoir contains chrysotile- up to 120 million fibers per liter at the Calaveras Dam Replacement Project (CDRP). The CDRP use up to a million gallons of water per day for dust control, translating into approximately 10E13 chrysotile fibers added to the fiber inventory for the duration of the project. Several questions emerge: Does this represent a significant increase in risk to workers and off site receptors? Are we running counter to the intent of dust suppression by using this water? What about using this water for personal decontamination? Unlike amphiboles where two sources may be differentiated by chemistry (amphibole species), chrysotile source differentiation must be accomplished through dimensional analysis. To achieve this, we are analyzing fiber dimensions of chrysotile in serpentinite rock, serpentinite soil, serpentinite road dust, and reservoir water. We then compare the fiber size distribution to chrysotile in emissions from vehicular traffic, near source construction area samples, perimeter station samples, and the distant ambient station samples. This presentation will review the techniques used to conduct dimensional analysis of chrysotile, and will present the conclusions regarding potential risk to workers and the public

Asbestiform minerals in nature, legal jurisdiction, and areas of responsibility: the Boulder City, Nevada, bypass project as a case study of misunderstanding and misconception

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The highway bypass project near Boulder City, Nevada, became controversial when asbestiform minerals were discovered in the vicinity of the construction site. News reports declared that "no one knows who is responsible" and other fallacious information. In fact, both OSHA and the EPA have clear jurisdictional boundaries in cases where human activity disturbs significant amounts of asbestiform material, whether in a building or rural construction site. In addition, the employer has well-defined responsibilities for preventing exposures. This presentation will discuss the roles and responsibilities of OSHA as well as the EPA, and the specific responsibilities of an employer when disturbing regulated asbestiform minerals. We will also discuss how the continued use of the term "naturally occurring asbestos" caused confusion among the public, the local regulatory community, and the journalists reporting on the story.

River Street Warehouse Fire: A Case Study of an EPA Emergency Response(when it rained asbestos on Portland)

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EPA responded to a request for support from Oregon DEQ. EPA mobilized a large group of staff and contractors. Within 48 hours of the fire, EPA had deployed teams to begin performing reconnaissance of the downwind areas in attempt to identify debris from the fire. Debris was found as far as a mile and a half south of the warehouse. Debris consisted of burnt roofing paper that contained 90% chrysotile asbestos and was friable to the touch. Initial air sampling data did not indicate elevated concenrations; however, the weather was rainy and damp. As the recon and recovery progressed and as EPA continued to monitor the air, the weather became warmer and drier. A data viewer provided real time extent of debris and assessment information so that the field ops and support ops could be well coordinated. This presentation will describe the sequence of events, present relevant data, and provide insights to an EPA emergency response.

Asbestos Soil Remediation: In Situ Versus Excavation and Disposal Off Site

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Prior to 2011, before the asbestos law was promulgated and reinforced in Israel asbestos waste was spread in vast areas of the Western Galilee region in Israel. Most of the waste originated from a local asbestos cement factory. This report compares the management of two unique sites. Prior to the selection of the proper management methods, essential factors were taken into consideration such as the future uses of the affected land, the form of the ACM related to the fiber release potential to the air, the extent of soil contamination and the approval of the authorities. The first step was to assess the amount and distribution of the ACM. Historical aerial photographs were a good source of initial information. Detailed ground surveys were conducted using the systemic grid-based inspection method to locate visible ACM and to determine the locations for trial pits and trenches to detect below ground ACM. Common to both sites, vegetation and non-ACM building material waste were ground and removed. The first 20 acre site located beside the former asbestos cement plant was approved for cleaning by excavation and disposal off site. A power excavator was used to excavate and load wet ACM into certified hazardous waste double wall bags using a specially constructed funnel. The bagged ACM was transported to a certified landfill. The second site was an abandoned limestone quarry surrounded by a National forest and was approved for in situ remediation. The restoration of the site included securing the sides of the quarry with a bed of rocks and changing the topography to minimize soil erosion. The site was capped with a clay layer compacted to the desired engineering values. The clay layer was covered with fertile natural soil. The final stage was the re-establishment of the natural vegetation. Both operations were closely supervised to minimize the release of asbestos fibers into the air as monitored by periodic sampling the air for asbestos fibers.

Respirable Asbestos in Soil

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In addition to quantifying the amount of total asbestos in soil it can also be very useful to quantify the amount of releasable or respirable asbestos fibers in that soil. This metric can provide more insight into the potential risk that the asbestos represents. The EPA in conjunction with the Idaho National Laboratory has developed a new instrument and methodology, the Fluidized Bed Asbestos Segregator (FBAS) which captures fibers liberated from soil onto filters for analysis by Transmission Electron Microscopy, typically via the ISO 10312 method. The elutriation process occurs in an enclosed glass chamber with carefully controlled air flow from below and a TEM cassette above. This technique has several advantages over the Superfund Method for the Determination of Releasable Asbestos in Soils and Bulk Materials also known as the Superfund Method or the Elutriator Method. The fluidized bed instrument has far fewer parts and all of the parts that come into contact with the sample are one time use disposables except for the glass vessel itself which is easily cleaned. The relative simplicity of the fluidized bed method allows for greater sample throughput and potentially much lower analytical cost. The performance of the two methods has never been directly compared till now. This presentation will review the data collected so far in our comparison of the two methods on actual client samples as well as spiked samples of known asbestos concentration.

Use of FBAS prepared soil samples to make cleanup decisions at an ACM-contaminated site

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EPA developed the Framework to Investigating Asbestos-Contaminated Superfund Sites in 2008. The framework recommends activity-based sampling (ABS) for making risk-based decisions about the need for cleanup at asbestos contaminated sites. In 2016, EPA Region 4 began investigating a site in Davidson, North Carolina, where deteriorating asbestos-containing material (ACM) was found on residential properties located near an abandoned industrial facility. EPA and others have referred to these types of facilities as "botched NESHAPs abatements." EPA continues to see more and more of these types of sites in our routine work. At this site, the Region 4 Removal Program didn't want to wait for ABS data to make decisions about whether or not cleanup of residential properties was warranted. As a result, residential soil was tested for asbestos using PLM (CARB 435). Once these results were available, a subset of soil samples was also tested using the FBAS followed by ISO 10312. These results showed very low levels of asbestos in soil especially when compared to standards tested in Januch et al (2013). As a result, residential properties with low levels of asbestos as determined by FBAS/TEM were not remediated.

Our Experience with Three Different Preparation Methods for Lung Tissue Fiber Burden Analysis

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There are numerous techniques available for lung preparation for asbestos analysis fiber burden studies. In support of an exposure study, our lab experimented with three techniques used to remove lung tissue to facilitate asbestos fiber detection and quantitation, High Temperature Ashing, Low temperature Ashing, and Bleach Digestion. All three techniques are very hands on, labor intensive and require great attention to detail of technique for consistent quality results. High Temperature Ashing has the appeal of potentially faster turnaround of large numbers of samples but is the most aggressive preparation technique. Low Temperature Ashing has the advantage of being less aggressive and therefore potentially gentler on the fibers than high temperature ashing but preparation times are much longer. Bleach digestion, at least in our hands was the most successful approach however it was also the most "techniquey". This presentation will cover some of the details of the study as well as our approaches to each of the preparation techniques. The resulting samples will be compared based on percent recovery and any effects on fibers present.

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